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National Library of Medicine Programs and Services Fiscal Year 1988

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES / Public Health Service
National Institutes of Health

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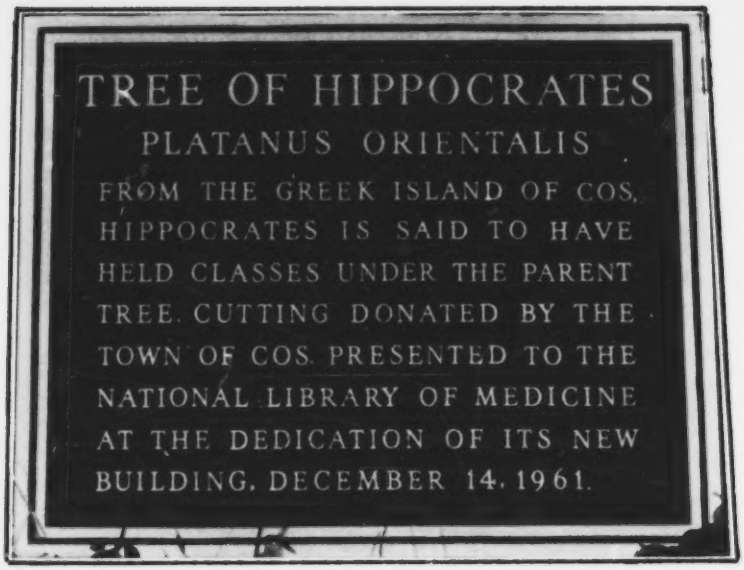
TREE OF HIPPOCRATES
PLATANUS ORIENTALIS
FROM THE GREEK ISLAND OF COS.
HIPPOCRATES IS SAID TO HAVE
HELD CLASSES UNDER THE PARENT
TREE. CUTTING DONATED BY THE
TOWN OF COS. PRESENTED TO THE
NATIONAL LIBRARY OF MEDICINE
AT THE DEDICATION OF ITS NEW
BUILDING, DECEMBER 14, 1961.

Further information about the programs described
in this administrative report is available from:

Office of Inquiries and Publications Management
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894
(301)496-6308

Cover: The "Tree of Hippocrates," a gift from the Greek island of Cos, was planted outside the National Library of Medicine on December 14, 1961. The cutting came from the very tree (platanus orientalis) under which Hippocrates is said to have conducted his classes some 25 centuries ago. The cutting was formally presented to the Library by the Ambassador of Greece to the United States.

National Library of Medicine

Programs and Services

Fiscal Year 1988

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES / Public Health Service
National Institutes of Health
Bethesda, Maryland

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Preface

The National Library of Medicine saw a significant expansion of its responsibilities in 1988 with the establishment of the National Center for Biotechnology Information. Early in the year the Congress appropriated funds to carry out biotechnology-related programs; in November 1988 President Reagan signed legislation that directed the formal establishment of the Center at the Library.

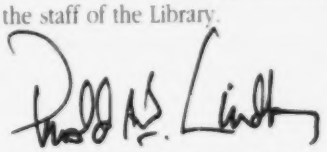
Briefly, the Center is given the responsibility to create automated systems for knowledge about molecular biology, to conduct research into advanced methods on how to handle biotechnology information, to enable those engaged in biotechnology research and in medical care to use the systems developed, and to coordinate the gathering of biotechnology information worldwide.

That same legislation also directed the Library to work with other Federal agencies to develop and make available a databank containing the results of AIDS research being conducted around the world. Independently, the NLM had announced earlier in the year a new MEDLARS file--AIDSLINE--that will be an important part of whatever AIDS information services eventuate from the legislation.

I am especially pleased with the expanding acceptance within the health community of the PC-based Grateful Med software for accessing MEDLINE and other NLM databases. Our user base jumped an amazing 50 percent this year, due primarily to the popularity of Grateful Med.

Although there is much useful information in the various program descriptions of this report, I would direct the reader's attention to the chapter titled "1988 Special Initiatives." There will be found a discussion of how the Library plans to update the Long Range Plan, brief descriptions of NLM's current work in biotechnology, the Unified Medical Language System and AIDS information, and a multi-part report on "outreach."

Finally, I would like to express my thanks for a job well done to all those connected with our grand enterprise--those who serve as advisors and consultants, those who join us in the MEDLARS online system, the Regional Medical Library Network and the international MEDLARS Centers, and, especially, the staff of the Library.



Donald A. B. Lindberg, M.D.
Director

Calendar of Events--Fiscal Year 1988

1987

September 30 - October 1: Board of Regents
October-January: "Health Care in a City of Immigrants, 1886-1917," exhibit in the Library's main lobby
October: Survey questionnaires mailed to 4312 users to assess health professionals' use of MEDLINE®
October 2: Symposium--"Images of the Health Professions in the Popular Arts"
October 13: Announcement to MEDLARS users by Director of no-charge policy for DOCLINE®
October 22: Biotechnology lecture: "Indexing the Human Genome"
October 29: Lecture by Gerald Oppenheimer: "Reminiscences--20 Years with the RML Program"
November 5-6: Biomedical Library Review Committee
November 5-6: Conference at NLM on history of medical informatics
November 10: Biotechnology lecture: "Information Technology and the Structure of Biological Theory"
November 16-17: Board of Scientific Counselors
December 16: Lecture on the history of sports medicine, Ernst Jokl, M.D.

1988

January: Two periodicals begin publication--*AIDS Bibliography* and *Current Bibliographies in Medicine*
January: Grateful Med Version 3.0 issued
January 13: Friends of the NLM ceremony, lecture, reception
January 15-16: Permanent Paper Task Force
January 27: Biotechnology lecture: "BIONET--A Network and Computer Resource for Molecular Biology"
January 28-29: Board of Regents
January 29: Visit by Shozo Shimomura, President, and delegation from MEDLARS partner Japan Information Center for Science and Technology
February-May: "Blacks in Medicine--The Institutional Setting," exhibit in the Library's main lobby
February 10: Biotechnology lecture: "Genetic Engineering and Crop Improvement"
February 12: National Center for Biotechnology Information Branch created within the Lister Hill Center
February 26: Historical lecture: "Towards Pluralistic Health Care: Medicine, Social Welfare and Urban Black Health Issues, 1900-1950," David McBride, Ph.D.
March 9-10: Biomedical Library Review Committee
March 18-19: History of ophthalmology conference
March 28: Biotechnology lecture: "Human Genome Project"
March 28-30: Workshop on Molecular Sequence Algorithms at the Lister Hill Center
March 29: "The Cancer Summit," conference via satellite between Moscow and the Lister Hill Center
April: MEDLINE® begins semi-monthly updates
April: Implementation begins of National Preservation Plan for the Biomedical Literature
April: NLM begins to identify and input molecular sequence data in indexed articles
April 1: Interlibrary loan charge increased by $2--to $7 for domestic loans, $9 for international loans
April 7: Fifth Leiter Lecture presented by Alvin M. Weinberg, Ph.D.
April 12: Preservation film data added to SERLINE®
April 14: Lecture by Gerald Geison, Ph.D., "Pasteur and the Ethics of Biomedical Research"
May-October: "A Century of American Dental Research," exhibit in the Library's main lobby

Programs and Services, FY 1988

May: DOCUSER® becomes available as a MEDLARS database, a directory to libraries using DOCLINE
May 2-3: Board of Scientific Counselors
May 17-18: Board of Regents
June 7: Biotechnology lecture: "Prospects for Human Gene Therapy"
June 9: Symposium on Physical Fitness and Sports Medicine
June 13: Permanent Paper Task Force
June 15-16: Biomedical Library Review Committee
June 16-17: Conference on "Documenting Modern Medicine: Problems and Prospects"
June 20-21: Ad hoc committee to advise on the Medical Library Resource Grants Program
June 27-28: Meeting of NLM training directors
June 29: New UMLS support contracts awarded
July: New AIDSLINE database
July: Number of DOCLINE requests exceeds one million in a year for the first time
July 19: Interagency agreement signed with the EPA to create a Toxic Chemicals Release Inventory
July 26-27 : Literature Selection Technical Review Committee
September: Total MEDLINE indexing was 329,000 citations for FY 88. Use of MEDLARS databases at NLM rose 10.5 percent to 312,320 connect hours; total searches increased 8 percent to 4.1 million; online codes in the U.S. and abroad totalled 17,451, up 41 percent since FY 1987
September 5-6: International MEDLARS Policy Advisory Group meets in Canberra, Australia
September 11-13: International Committee of Medical Journal Editors
September 16: Biotechnology lecture: "Transgenic Mammals and Biotechnology"
September 23: CD-ROM Conference

1988 Special Initiatives

Last year's report described three "special initiatives": the Unified Medical Language System, Permanent Paper, and Biotechnology. This year the Special Initiatives chapter describes the Library's implementation of the Long Range Plan and plans to update it, biotechnology activities, the new outreach effort, current work on the Unified Medical Language System, and AIDS-related information activities.

NLM Long Range Plan

In January 1985, NLM's Board of Regents undertook to develop a Long Range Plan to guide the Library in using its human, physical, and financial resources to fulfill its mission. A broad based process was begun involving the participation of librarians and information scientists; physicians, nurses, and other health professionals; biomedical scientists; computer scientists; and others--some 130 distinguished persons in all. This culminated in the adoption of a Report by the Board of Regents containing 16 major goals, 51 recommendations, and resource requirements for Fiscal Years 1988-1990 for accomplishing the long range goals. The Report emphasizes the present urgent need for improved access by health care professionals and scientists to the fast growing literature of newly discovered biomedical concepts, treatments, and preventatives--across a wide range of practical and theoretical problems.

NLM is following the recommendations quite carefully in the management of the Library and the implementation of new activities. It is important to integrate the planning and budget processes as closely as possible so that the Long Range Plan "drives" the budget formulation process and not the other way around. To this end, the Office of Planning and Evaluation, with the Office of Financial Management and the Library's operating divisions, have developed a three-tiered planning and budget system:

Tier 1: NLM operating and functional budgets integrated within the Long Range Plan

Tier 2: Tracking system for 51 Long Range Plan recommendations

Tier 3: 9 high priority initiatives

It now seems advisable to update the plan in several newly emergent areas and in some areas that were not completely specified in the original Plan. Three areas currently identified are:

A. Outreach Initiative--previous LRP recommendations relating to outreach include:

2.2.6 Encourage basic and applied research to identify health professionals' need for, access to, evaluation of, and use of biomedical information, and where feasible, examine the relationship between access to information and quality of patient care.

2.2.1 Enhance GRATEFUL MED and develop other user-cordial systems to facilitate direct access to biomedical information.

2.1.1 Enhance the RML network to assure that it is able to use emerging technologies and to serve successfully as a test bed for new communications systems.

B. Electronic Image Library--previous LRP recommendations relating to Image Libraries include:

5.3.2 NLM should thoroughly and systematically investigate the technical requirements for and feasibility of establishing a biomedical images library.

C. Training Medical Librarians--previous LRP recommendations relating to training medical librarians:

2.3.1 Institute new prototype programs containing special curricula in U.S. library and information science schools that emphasize integrated information concepts and the application of new technologies to information dissemination.

Under the direction of the Board, NLM will bring in working groups of consultants to develop more detailed plans in these three targeted areas. For the first area, an Outreach Panel has been assembled, chaired by Dr. Michael DeBakey and consisting of health professionals, medical librarians, members of health-related associations, experts in management and marketing, and others familiar with NLM and RML capabilities. Some will have served on the earlier planning panels or as consultants to the planning process. The Panel will be advisory to the Board of Regents.

The Outreach Panel will meet three times: in November 1988, January 1989, and March 1989. A final report containing recommendations for an NLM Outreach Plan, including the recommended roles for the RML network, will be expected from the Panel in the spring of 1989. The other two panels are expected to begin their activities in 1989.

E. Siegel

Biotechnology

The importance of computer and information science as applied to molecular biology continues to grow; computer databases for biotechnology are swelling rapidly with new molecular data. In the past year scientific and Congressional attention to a proposed project to sequence the entire human genome has resulted in appropriations earmarked for the laboratory science aspects of sequencing large and complex stretches of DNA. In addition, the Library received special appropriations to initiate a National Center for Biotechnology Information (NCBI). In 1988, the Center was created as a branch of the Lister Hill National Center for Biomedical Communications, and Dr. Dennis Benson was named as its chief. Consonant with the goals of NLM's Long Range Plan for factual databases, the NCBI will focus on making molecular biology data more complete and accessible to biomedical researchers, and improving the computer-based methods for its analysis. Examples of NCBI-sponsored biotechnology projects during 1988 included:

- GenInfo, a prototype multi-database access system which allows a researcher to express a question in his own words, and have it answered by information retrieval from a dozen different databases containing molecular data. As implemented on graphical workstations, the system can display pictures of molecules and chromosomes as well as related text.

- A contract with Dr. David Mount and colleagues at the University of Arizona to develop a computer program to support analysis by investigators who use the techniques of "shotgun sequencing" of DNA. This analysis software takes as input the patterns of DNA fragments produced by cutting DNA into many small pieces with enzymes, and permits computer-based "reassembly" of the pieces into the most likely original order along the DNA strand. Software of this type is an essential tool for the human genome project.

- Linkages among biotechnology information sources. 1988 saw the completion of projects to map GenBank keywords to the closest related MeSH heading, so that related literature may be searched and retrieved based on GenBank record selections. As well, the MEDLINE unit record for

literature referencing entries in molecular databases was enhanced by addition of database accession numbers. For example, if an article reports a new DNA sequence and that sequence is deposited in GenBank, the MEDLINE record will contain the GenBank unique identifier for the sequence data.

- Computer network linkages. High-speed computer communications lines were installed to connect the Lister Hill Center to the other major NIH scientific computing centers at the Division of Computer Research and Technology, and the National Cancer Institute's supercomputer facility in Frederick, Maryland.

- Scientific computing conferences. A March 1988 workshop on Algorithms for Sequence Analysis was representative of an ongoing commitment to bringing together talented researchers in both biology and computer science.

The promise of molecular biology is indeed profound. The distant and lofty goal of knowing and understanding the entire genetic instruction set for a human being has been stated as "given the DNA sequence of the human genome, infer man." This will be the science of the 21st century, a science which will be intimately dependent upon computers for the representation, communication, and analysis of data. The National Library of Medicine is committed to making that future a reality by fostering the application of advanced information technologies to the molecular life sciences.

D. Masys

Outreach

The rubric chosen for all aspects of how the Library interacts with the health professional community and the public is "outreach." As used, the term can refer both to the library and biomedical information services provided by NLM to users outside of its Bethesda facility and to such activities as exhibits, brochures, articles, and so forth, intended to inform people about the Library. The following four subsections address different aspects of outreach.

A. User interfaces and services. One of NLM's fundamental missions is to improve intellectual and physical access to the biomedical literature for U. S. health sciences practitioners and researchers, wherever they are located. The Library attempts to achieve this goal by describing the content of the biomedical literature through authoritative indexing and cataloging, by disseminating its indexing and cataloging data widely in a variety of formats, and by facilitating access to the actual documents described. In its efforts to improve the efficiency of these services, NLM relies on two basic strategies: creative use of new technology, as exemplified by the development and enhancement of MEDLARS, and collaboration with other health sciences libraries throughout the U.S., primarily through the Regional Medical Library Network.

For much of the Library's history, access to its authoritative cataloging and indexing has required the use of tools--at first publications and later also databases--that were generally available only in libraries. Individuals were not prohibited from obtaining direct access to these tools, but factors such as space, cost, equipment, and training requirements tended to discourage it. In the 1980's, as more and more individual health professionals and researchers began to have access to personal computers, NLM took a number of steps to encourage these individuals to search NLM's online databases directly, such as the development of GRATEFUL MED® and the implementation of reduced rates for searching by health sciences students. Direct online access allows health professionals to obtain needed information immediately as a problem or question arises and in

locations where library service is not readily available. Librarians throughout the Regional Medical Library Network have assisted in NLM's effort to encourage individuals to search directly by providing special demonstrations and short training courses in online searching and by serving as consultants in the selection of appropriate hardware, software, and database services.

By the close of FY 1988, there were 8,082 individual users of NLM's online services. During the first year of NLM's new student code policy, 2,678 institutional and individual student codes were issued. Of the 3,040 individuals who obtained online codes during the year, 76 percent indicated that they intended to use GRATEFUL MED. A total of 11,650 copies of GRATEFUL MED have been sold by the National Technical Information Service since the introduction of the package in March 1986. Purchasers of GRATEFUL MED automatically receive new versions of the software as they become available. In January 1988, Version 3.0 was issued, offering users access to seven additional MEDLARS databases. Other new features included: the ability to edit and rerun the previously submitted search, improved access to MEDLINE backfiles, simplified installation procedures, and new documentation. Version 4.0 should be available early in 1989.

In addition to simplifying access to its own online services, NLM has encouraged the private sector to develop user friendly CD/ROM versions of MEDLINE under experimental licensing arrangements. At the end of FY 1988, there were 7 commercially produced MEDLINE CD/ROM products on the market. Under the terms of the experimental agreements, which ended this year, each of these products was installed and evaluated at three sites selected by NLM. Representatives of the CD/ROM producers and the twenty-one different sites participating in the evaluation program discussed their experiences in developing and evaluating the products at an all-day evaluation forum, MEDLINE on CD/ROM, held at NLM on September 23, 1988. It appears that the experimental agreements and the evaluation program have fostered private sector development of a variety of high-quality MEDLINE CD/ROM products.

Once health professionals and researchers have retrieved references and abstracts from MEDLINE, the next step may be to obtain copies of the complete text of some of the articles described. The structure of the Regional Medical Library Network ensures that the combined collections of the nation's health sciences libraries can be made available to users of any node in the network, from the smallest hospital library to the largest academic health sciences library. NLM's DOCLINE system provides automated support to the transfer of document requests throughout the system. Linked to MEDLINE and CATLINE, DOCLINE allows staff at participating libraries to create requests for articles or books without rekeying bibliographic information already in these NLM files. DOCLINE uses data in SERHOLD®, NLM's automated file of over 1.1 million serial holdings statements representing the serials collections of 2,600 network libraries, to route requests for journal articles automatically to an appropriate library. In FY 1988, 1.26 million document requests were entered in DOCLINE, and 92 percent of them were filled. At the end of the year, there were 1,668 DOCLINE participants. NLM does not charge libraries for the use of the system, which is NLM's contribution to the national interlibrary loan infrastructure. Participating libraries also contribute to this infrastructure by submitting automated holdings data to SERHOLD and by adhering to national standards for response time to requests and maximum charges for interlibrary loan service.

NLM and the RML Network have begun to examine administrative and technical issues related to use of DOCLINE by individual health professionals and researchers. The Louise Darling Biomedical Library at UCLA, the Region 7 RML, will submit the results of a special project to examine the

administrative and policy aspects of such direct access to NLM in early FY 1989.

B. Humphreys

B. Public Affairs. Before the NLM Sesquicentennial in 1986, the public affairs/outreach activities of the NLM were fairly limited: a monthly newsletter (audience: primarily medical librarians), an occasional press release (usually announcing a staff or Board of Regents appointment), several brochures and fact sheets, and 6-8 exhibits each year at professional meetings. The NLM Sesquicentennial was seen by the Board of Regents as an opportunity to change this low-key outreach activity; the Board created a Subcommittee on Education/Outreach and directed the Library to expand its public affairs program. The result was a remarkable number of newspaper and magazine articles, editorials, radio and television announcements, posters, exhibits, and special events. From the *New York Times* to the *Readers Digest* to the *White Mountain Independent* (Arizona), from "Paul Harvey News" to CBS's "American Heritage," the Library was made known to millions who had never been aware of its existence.

Now, with the additional impetus of a mandate from the Congress to "publicize" its programs and services, the Library is planning to continue and expand on the work begun in 1986. There is in place already an elaborate infrastructure on which to build: the Regional Medical Library Network, the national online network of some 20,000 users, an international network of 16 major medical institutions working formally with the NLM to bring the benefits of modern information technology to health professionals worldwide, and legislative authority for a wide-ranging program of grant assistance, to name a few. The question is, How does the Library leverage these considerable resources so as to maximize the impact of its services on the health of the public?

The general goals of the outreach program, as initially stated, are to (1) inform all health care professionals of the services available to them from NLM, and (2) establish a link between NLM and these users so that we are continually made aware of successful and unsuccessful uses of our services and so we can learn about the need for additions and improvements. In short, we want a way to know that what we do really helps.

R. Mehnert

C. Baseline data. An important aspect of outreach is to establish a baseline of knowledge about current users and uses of NLM's systems. What follows are brief descriptions of a just completed survey of MEDLINE users, conducted by staff of Library Operations, and a "Critical Incident Technique" (CIT) study, now being conducted by staff of the Office of Planning and Evaluation.

In the fall of 1987, NLM conducted a survey of individuals who had personal codes for accessing MEDLINE (as of July 1987). The purpose of the survey was to determine the demographic characteristics of individual users of MEDLINE, their methods of access to the system, their reasons for searching, and their level of satisfaction with current system features and capabilities. Approval to conduct the survey was obtained from the U. S. Office of Management and Budget as required by the Paperwork Reduction Act.

A total of 2,716 individuals, or 68 percent of those surveyed, returned usable responses. The survey data reveal two different groups of individual users, although in some cases the same individuals probably belong to both groups. The first group is concentrated in academic settings, uses MEDLINE primarily in support of research, and is typically interested in comprehensive retrieval. Most of the people in this group are physicians or physician-scientists. The majority in the "research" group (as

of October 1987) still used the command language. The second group is made up predominantly of physicians who work in various clinical practice settings. They use MEDLINE primarily in support of patient care and are more likely than the "research" users to wish to retrieve just a few relevant citations. A larger percentage of this group already used Grateful Med as compared to the "research" group. At the time the survey was conducted, the "research" group was slightly larger than the "patient care" group; but there is evidence that the "patient care" group is growing at a faster pace.

Although the "research" and "patient care" groups have some key differences, they also have many important attributes in common. In general they are relatively young physicians or scientists with access to microcomputers. They are likely to do all their own searches. Overwhelmingly they use MEDLINE to satisfy immediate information needs rather than to stay current in their fields or to learn about new areas. They typically search by subject. In general, they are quite satisfied with MEDLINE.

The system enhancements most frequently suggested by respondents to the study were improved MEDLINE backfile searching and improved printing capabilities. NLM had already begun to take steps to improve backfile searching and printing capabilities at the time the survey was conducted. The 27 percent of respondents who provided free-form comments on satisfactory aspects of NLM's online service listed the content of MEDLINE, hours and availability, speed and efficiency, Grateful Med, and cost as the most satisfactory aspects of the system. Among Grateful Med users, Grateful Med itself was the most frequently mentioned satisfactory aspect. The 32 percent who provided comments on the least satisfactory aspects listed specific Grateful Med limitations, backfile searching, and MeSH vocabulary and indexing policy most frequently. Several of the Grateful Med limitations mentioned were corrected in Version 3.0 which was released shortly after the survey was completed.

Although those who use the service are satisfied, the survey results provide additional evidence that NLM's success in attracting individuals to the use of MEDLINE has been restricted to physicians and scientists. Very few nurses, dentists, veterinarians, and other health professionals have become individual users of NLM's online services.

A complete report of the results of the survey will be published in FY 1989 as a technical report available from the National Technical Information Service. Its availability will be announced in the *NLM News*.

B. Humphreys

D. Critical Incident Technique (CIT). As part of the NLM's mandate, the Library has an ongoing responsibility to assess the extent to which its information products and services support the requirements of its users. This enables the NLM to craft ever more responsive systems that capitalize on the latest advances in information and computer technology and, when necessary, to modify existing systems whose performance may no longer be optimal or consistent with the functions intended or the changing needs of its users.

The goal of NLM's Critical Incident Technique (CIT) study is to understand and document how MEDLINE-derived information is used, especially in patient care, and with what effects. In essence, the study seeks to answer the question: Does the use of MEDLINE make a difference? That is, what is the impact of having obtained and used MEDLINE-derived information? A related goal is to create an "evaluation feedback loop" wherein study findings will be used to modify and/or enhance MEDLINE in ways which increase the likelihood that health professionals will obtain a positive search outcome. This will be dependent upon collecting CIT data that adequately describe the behaviors leading to and

associated with a successful or unsuccessful MEDLINE search.

The CIT is a scientifically based analytical methodology that is used to determine critical requirements which have been demonstrated to make the difference between success and failure in carrying out an important part of a task in a significant number of instances. Quite literally, its objective is to obtain valid information regarding the truly critical requirements for success. To do so, specific procedures are followed to make a systematic analyses of "causes" of good and poor performance. In essence, the procedures obtain first-hand reports, or reports from objective records, of satisfactory and unsatisfactory execution of the task in question. Observers describe a situation--the incidents--in which success or failure was determined by specific reported causes.

Stated in CIT terms, the specific objective of the present study is to focus on the community of health professionals, and to obtain from these individuals first-hand reports (i.e., the critical incidents) of how the use of MEDLINE-derived information is or is not helpful in dealing with problems that are part of the professional practice of medicine. Such information is vital to determine whether the MEDLINE database is configured optimally to fulfill the information needs of health-professional users; and if not, to know how the Library can make it better. Knowing that the use of MEDLINE "makes a difference," that information retrieved from MEDLINE is used successfully to support medical decision-making for patient care, for example, is of importance to NLM management and the governmental bodies that fund its programs.

The population to be sampled in this study are users of NLM's MEDLINE database. They will be identified and selected in part from respondents to the NLM survey described in the preceding section and from nominations of individuals by the Regional Medical Library Network from among those persons trained to do their own searches and/or who use the services of a search intermediary.

The approach to be taken calls for the collection of reports of critical incidents by means of telephone interviews with study participants who use MEDLINE in their professional practice of medicine. Respondents will be encouraged to report as many incidents as is feasible. Each incident will be comprised of a comprehensive data set describing the problem or clinical question for which MEDLINE information was sought; the antecedent circumstances leading to the use of MEDLINE as an information source; the behaviors associated with carrying out or requesting the actual search; the information obtained; how the information was used; and the result or impact of having obtained and used the information.

The study is scheduled for completion in late 1989.

E. Siegel

Unified Medical Language System

The Unified Medical Language System (UMLS) project is an effort to build an increasingly intelligent automated system that understands biomedical terms and their interrelationships and uses this understanding to help users retrieve and organize information from machine-readable sources. The goal of the UMLS is to facilitate the retrieval and integration of information from a variety of machine-readable information sources, including descriptions of the biomedical literature, clinical records, factual databanks, and medical knowledge bases. The UMLS will compensate for the differences in the terminologies used in these disparate systems and for variations in the language employed by users themselves.

A project of the breadth and complexity of the UMLS naturally requires the knowledge and skills of experts in many fields. For this reason, the UMLS development strategy involves a combination of

internal research and development at NLM itself, competitively awarded contracts for research assistance with several U. S. research institutions, collaborative projects with other governmental or national agencies, and advice from professional associations and other interested groups in the private sector. The American Medical Association is assisting NLM by coordinating input from the private sector groups.

The UMLS project was initiated in 1986 after a year of preliminary exploration of alternative mechanisms for pursuing the work. The primary objectives for the first two years were to: (1) define the components of the UMLS, (2) test alternative approaches to the development of these components, (3) describe the existing biomedical vocabularies and databases which the UMLS must understand, (4) describe the information needs of the intended users of the UMLS and the user language that expressed these needs, (5) develop tools for evaluating the usefulness of components and capabilities derived from UMLS research, and (6) make useful interim products publicly available. This two-year phase concluded in August 1988 with the completion of the first round of UMLS research and development contracts.

Specific plans have been completed for the development of the first version of the UMLS Metathesaurus, a new knowledge source that will contain information about biomedical concepts and their representation in various vocabularies and thesauri. The Metathesaurus will represent a variety of relationships among terms and will support mapping from the user's terms to selected controlled vocabularies and among these different controlled vocabularies. Among the interim UMLS products that became available in FY 1988 is the search engine feature of Grateful Med, which makes it easier to imbed access to the MEDLARS databases within other special purpose computer programs. The AI/RHEUM expert knowledge-based system currently maintained at NLM and the QMR knowledge-based system developed at the University of Pittsburgh have both been modified to use the Grateful Med search engine to perform MEDLINE searches for their users. MicroMeSH, another UMLS product, developed by Massachusetts General Hospital, was distributed to several sites for testing in FY 1988. MicroMeSH is a microcomputer-based tool for searching and graphical display of relationships among MeSH terms which also provides access to the MEDLARS system. Recent UMLS-related enhancements to the Medical Subject Headings (MeSH) are described in the chapter on Library Operations.

In June 1988, five new three-year UMLS research and development contracts were awarded to the following organizations:

Lexical Technology, Inc.
Principal Investigator: Mark S. Tuttle

Massachusetts General Hospital
Principal Investigator: G. Octo Barnett, M.D.
Subcontractor: Brigham and Women's Hospital
Principal Investigator: Robert Greenes, M.D., Ph.D.

University of Pittsburgh
Principal Investigator: Randolph Miller, M.D.
Associated Senior Investigator: Bruce Buchanan, Ph.D.

University of Utah
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With the award of a new set of contracts for development support in June 1988, the project is moving from background studies and the exploration of alternative structures and approaches to the actual building of the initial versions of central UMLS components. Accordingly, the major objectives for

the next three years of UMLS development are to (1) develop and distribute the first version of the UMLS Metathesaurus; (2) design and develop the first version of the UMLS Information Sources Map, and (3) test and evaluate these UMLS components in a variety of settings. Further research on user information needs and the development of useful interim products will also continue to be high priority objectives during the next three years.

B. Humphreys

Activities Related to AIDS

Research results are of little value if they are not easily accessible to scientists and clinicians, and at no time in history has this been more evident than with the AIDS epidemic.

The recently enacted Health Omnibus Program Extension of 1988 (P.L.100-607) calls for NLM's involvement in the establishment of a "data bank on information on the results of research with respect to acquired immune deficiency syndrome conducted in the United States and other countries" ((Sect. 2317 (c)). NLM laid the foundation for such a data bank by initiating several bibliographic services such as the *AIDS Bibliography* and the new online service AIDSLINE.

The first issue of the *AIDS Bibliography* was published in 1983 as one of the series of NLM literature searches. It contained MEDLINE references from January 1980 through April 1983 in alphabetic order by author. Initially, the bibliography was sent to 900 libraries and institutions, NIH staff working on AIDS, and other researchers in the field. Eight supplements to this bibliography were published between 1983 and 1985. The mailing list grew to include organizations in health care, health education and public health, state health departments and other groups working in the AIDS area. Between 1985 and the end of 1987, the *AIDS Bibliography* was available quarterly without cost from NLM and a special monthly update was sent to about 100 researchers and policy makers to enable them to keep up-to-date.

In January 1988, NLM made arrangements with the Government Printing Office (GPO) to start distribution of the quarterly *AIDS Bibliography*. NLM now supplies camera-ready copy which GPO prints and distributes. The bibliography now has some 1400 subscribers. During the year, NLM improved the publication by arranging the citations under twelve general subjects. Because of the continuing growth of the AIDS literature and interest in the field, NLM will produce the bibliography on a monthly basis in 1989. The publication will be printed using the regular NLM *Index Medicus* print routines, thus further reducing staff time.

By early 1988 there were about 12,000 citations in MEDLINE on AIDS and AIDS-related diseases, organisms, and drugs. NLM staff were often asked by NIH researchers and others to assist in developing appropriate search strategies to retrieve citations from MEDLINE about certain aspects of the AIDS literature.

It was about this time that the Director of the Library asked staff about what NLM could do to assist health professionals working on AIDS--researchers, administrators, or those delivering health care. At the top of the list of suggestions was a special online bibliographic database for AIDS. It was agreed to develop such a service and work on the database was begun immediately. AIDSLINE--as the new service was called--was made available as a component of the NLM online system in July 1988. In January 1989 it will also become available for lease to domestic vendors and foreign organizations.

The 15,000 references now in AIDSLINE cover clinical and research aspects of the disease, epidemiology, and health policy issues. Forty percent of the records have author-produced English language abstracts. The citations cover the period 1980 to the present. The database is updated twice a month with the addition of 400 records each month.

It is estimated that users do some 1200 searches on AIDSLINE each month, making this the sixth most widely used bibliographic database on the NLM system. Searching of AIDSLINE also has been facilitated by adding this file to the menu in GRATEFUL MED.

Future plans for AIDSLINE include the addition of some 600 citations from the HEALTH Planning and Administration database in April 1989, 1,000 citations from CANCERLIT® in June, and 600-800 citations from BIOETHICS in September. It is planned also to abstract annually for AIDSLINE information from some five major AIDS meetings. NLM staff are continuing to monitor the literature for specific AIDS-related terms to be added to MeSH in order to help searchers of all the MeSH-indexed NLM databases.

In addition to starting these bibliographic services, NLM also initiated other activities to assist users in finding information about AIDS. NLM's online directory service DIRLINE® was enhanced with references to some 300 national organizations that can provide information and services regarding AIDS. This was done in cooperation with the National AIDS Information Clearinghouse. Furthermore, NLM has initiated collaborative work with NIH's National Institute of Allergy and Infectious Diseases to mount in 1989 a new NIAID database on AIDS Clinical Trials for online access on the NLM system.

A comprehensive AIDS information service is needed to provide scientists, physicians, and other health professionals faster access to more complete U.S. and international information in the AIDS research, diagnosis, treatment, control, and prevention areas. NLM's mission to collect, retrieve, and disseminate biomedical information is an integral part of the research process. The NLM's own collection of some 4 million items, its MEDLARS computerized databases, and its Regional Medical Library program are the pillars of a national health information network--a network to ensure timely dissemination of scientific and medical information concerning this important disease to the biomedical community.

L. A. Colaianni and H. Kissman

Library Operations

Lois Ann Colaianni
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The Library Operations (LO) Division of NLM:

- acquires and preserves the world's biomedical literature;
- organizes that literature by cataloging and indexing;
- disseminates indexing and cataloging data in publications, online files, and other machine readable forms;
- lends or copies documents in the NLM collection as a backup to document delivery service provided by other U.S. biomedical libraries; and
- provides reference and research assistance to health professionals.

More than 250 librarians, technical information specialists, subject matter experts, health sciences professionals, and administrative support personnel carry out Library Operations' programs and services. They are organized in four main divisions: Bibliographic Services, Public Services, Technical Services, and History of Medicine; two special units: the Medical Subject Headings Section and the Regional Medical Library Program office; and a small administrative group in the Office of the Associate Director.

Planning and Management

With the publication of the NLM Long Range Plan in January 1987, LO senior staff saw the need to develop a common understanding of the basic vision and direction represented by the NLM Plan and to integrate the Plan's specific recommendations with other critical LO responsibilities. In FY 1988, the LO Division Chiefs, Section Heads, and their assistants undertook to develop this common view, to establish specific objectives for the next three years to ensure that aspects of the NLM Plan are achieved, and to define strategies for accomplishing these objectives. A plan for FY 1989-1991 was completed and distributed in August 1988. While this planning effort proceeded, the staff continued to work on implementing many of the recommendations in the NLM Long Range Plan. Accomplishments related to the NLM Plan are described throughout this chapter.

LO also continued to implement the recommendations of the seven management studies conducted in FY 1986-87 as part of a required governmentwide productivity improvement program. Among the recommendations implemented in FY 1988 were: restructuring of organizational units and establishment of subordinate supervisors in the Reference and Index Sections, a thorough review of NLM's publications exchange program, revision of performance standards for selectors, and revision of procedures for quality control of cataloging records and for cataloger performance evaluation.

Collection Development

Collection development activities include developing and maintaining literature selection policies, identifying and acquiring biomedical literature in all formats and languages, processing materials as they are received, and maintaining and preserving the collection. NLM's collection currently comprises 1,873,386 printed books, journal volumes, theses, and pamphlets and 2,112,866 other items, including audiovisuals, computer software, microforms, prints, photographs, and manuscripts.

Selection. Materials are selected for the NLM collection according to the guidelines described in the *Collection Development Manual of the National Library of Medicine.* In FY 1988, NLM reviewed the Library's coverage of biotechnology journals and also conducted preliminary reviews of general collection coverage in the fields of health care

technology assessment and sports medicine. The collection appears to be appropriately strong in all of these areas. Many books are selected for NLM through approval plans with book vendors. During the past year, the Library modified its procedures to make more effective use of these arrangements and to reduce the number of individual orders placed for specific books. In direct response to a recommendation in the NLM Long Range Plan, the History of Medicine Division convened a working conference of historians, librarians, and archivists to discuss elements of a national strategy for identifying, acquiring, and preserving historically significant manuscripts and other records of 20th century medicine and biomedical research.

Acquisitions. In FY 1988, a total of 45,287 volumes and 162,283 other items (e.g., audiovisuals, microforms, pictures, manuscripts) were added to the NLM collection. The Library received and processed more than 153,000 books, serial issues, audiovisual programs, and software packages. Significant additions to the historical collections included: Carl Scheele's *Chemische Abhandlung von der Luft und dem Feuer* (1777), describing his discovery of oxygen, made prior to the independent isolation of the gas by Joseph Priestley; two extremely rare works each describing the independent discovery of the lymphatic system, Thomas Bartholin's *Vasa Lymphatica* (1653) and Olof Rudbeck's *Nova Excercitatio Anatomica* (1653); an important work by William Harvey, *Excercitatio Anatomica de Circulatione Sanguinis* (1649), in which he responded to the critics of his classic *De Motu Cordis* (1628); a rare set of 17 eighteenth-century anatomical engravings by Antonio Cattani; the manuscript diary, with extensive medical content, of Confederate surgeon Franklin B. Shuford, kept during his tenure as an assistant surgeon at Chimborazo Hospital in Richmond, 1861-1865; additional manuscript materials to augment the Library's collection of personal papers of the noted American biochemist A. Baird Hastings; and several important historical audiovisuals donated by the American College of Obstetricians and Gynecologists, including a controversial 1938 film on "The Birth of a Baby."

During FY 1988, NLM took steps to improve acquisitions methods for foreign materials by expanding its use of the Library of Congress' Overseas Acquisition Program to obtain additional publications and posters from the Middle East, South America, and Africa. NLM also reviewed and updated its records for the Library's agreements for exchange of publications. Automated support for ordering and processing new books was substantially improved by the implementation of a new front-end system which makes use of the Model 204 database management package.

Collection Preservation and Maintenance. NLM's comprehensive program for preservation of the biomedical literature includes: preservation and maintenance of NLM's own collection; support for preservation of important biomedical literature not held by NLM; research on the use of new technologies for preservation of library materials; and promoting the use of more permanent materials in biomedical publications.

In FY 1988, the preservation microfilming contractor filmed about 6 million pages, a significant increase over the previous year. In addition, 777 rare books, manuscripts, and historical films received special conservation or preservation treatment. Work began on the development of automated support for binding and preservation microfilming of books. The project to insulate NLM's film vault was completed. Responsibility for NLM's pre-1970 audiovisual collections was transferred from the Public Services Division to the History of Medicine Division.

The final version of the National Preservation Plan for the Biomedical Literature was completed and distributed throughout the Regional Medical

Library Network. Several of the plan's recommendations have been implemented. NLM has established a program to borrow journal issues missing from the NLM collection from other network libraries so that complete sets can be microfilmed. Preservation reference collections have been established at the Regional Medical Libraries. The New York Academy of Medicine conducted a preservation needs assessment survey of U. S. biomedical collections as an RML enhancement project. NLM developed and taught preservation courses for RML staff and the Medical Library Association. The Library also prepared a poster and traveling preservation exhibit for use in biomedical libraries across the country. Information about NLM's preservation masters for journals was added to SERLINE, NLM's online serials database, where it is accessible to the network.

Acidic paper is the chief cause of the embrittlement and deterioration of library collections. The NLM Board of Regents adopted in February 1986 a preservation policy that includes the reduction of the future preservation problems by encouraging the publication of current biomedical literature on acid-free paper. Following a hearing on the use of permanent, acid-free paper in January 1987, the Board established a Permanent Paper Task Force to develop and implement strategies for increasing the use of acid free paper in scholarly biomedical publications. Co-chaired by Gerard Piel, Chairman Emeritus of *Scientific American*, and Lois DeBakey, Ph.D., Professor of Scientific Communication, Baylor College of Medicine and former member of the NLM Board of Regents, the Task Force includes a distinguished group of commercial, academic, and professional society publishers, paper manufacturers, printers, editors, and librarians. In two plenary sessions and several subgroup meetings, Task Force members have developed informational materials to distribute to publishers describing the availability of acid-free paper and proposed methods for identifying the use of acid-free paper in publications and in the bibliographic records that describe them so that future unnecessary preservation expenses can be avoided. The Task Force also is continuing to contribute to the development of government and industry standards for the making and use of permanent paper.

To date, Task Force activity has resulted in a number of news items and articles about the problem of paper deterioration and the Library's effort to promote use of acid-free paper in professional and lay journals, newsletters, and the Congressional Record. To support the Task Force's activity, NLM's Serial Records Section has developed mechanisms to record the conversion of serial publications to acid-free paper in the Library's automated serial system.

The Library's research activities related to preservation are described in the report of the Lister Hill Center.

Bibliographic Control

NLM's Bibliographic control activities include maintaining and enhancing the Medical Subject Headings (MeSH)® and the NLM Classification; cataloging all types of biomedical literature; and indexing journal articles on biomedical subjects.

Thesaurus. MeSH, the hierarchical thesaurus used in cataloging, indexing, and online retrieval of citations to the biomedical literature, contains 15,442 subject heading its Supplementary Chemical file contains about 50,000 terms, principally names of chemicals. Each year NLM staff review, update, and modify the terminology as necessary to reflect new developments in biomedicine and changes in biomedical terminology. In FY 1988, 319 new MeSH terms and 2947 cross-references were established for use beginning in January 1989. The changes made included new terminology in the fields of AIDS, molecular biology, and leukemia. Work also began

on a project to update the MeSH vocabulary in the field of epidemiology. NLM has issued a contract to the Council on Health Care Technology of the Institute of Medicine to advise on enhancing the vocabulary of technology assessment.

A new automated system for online creation and maintenance of the MeSH vocabulary file was implemented at the end of FY 1988. The new system, which uses the Model 204 database management software, contains many automatic data generation and validation features that will cut time-consuming proofing operations and improve the quality of the MeSH file. The system also supports the addition to MeSH records of information needed for the development of the Unified Medical Language System (UMLS).

In another activity related to the UMLS project, NLM staff continued to build the MeSHLINK file, which stores mappings between MeSH and other vocabularies that cannot be incorporated in the basic MeSH file structure. To date, 10,685 mappings between Library of Congress (LC) subject headings and MeSH headings have been added to the file. Another 3,716 LC subject headings have been determined to have no reasonable MeSH equivalents.

Cataloging. NLM's cataloging activities include: original cataloging of new works added to the NLM collection; maintaining the automated files of NLM's cataloging records and the authoritative forms of names used in those records; and maintaining the NLM classification, which is used to assign a shelving code identifying the principal subject of each cataloged item. In FY 1988, a total of 20,656 books, serials, audiovisual programs, and Cataloging-in-Publication (CIP) galleys were cataloged for the Library by NLM staff, contractors, and through an interagency agreement with the Library of Congress. At the end of the year the longstanding backlog of uncataloged books had been reduced by 2,827 items. There are now 9,362 books awaiting cataloging.

Several changes were made to the automated systems that support the cataloging process. Software for downloading name authority records from the Library of Congress' Name Authority File and transferring them to NLM's Name Authority File® was developed and implemented. Both AVLINE® and the catalog record creation programs were modified to accommodate properly constructed records for computer software acquisitions. Work began to develop a new cataloging data entry and maintenance system which will make extensive use of personal computer workstations.

A multi-year project to update the NLM Classification was initiated. Pauline Atherton Cochrane, an authority on subject access to library materials, is serving as a consultant to the Library on the project. NLM is also seeking advice from selected health sciences libraries through a cooperative project with the Technical Services Section of the Medical Library Association (MLA).

In FY 1988, MLA's Technical Services Section also conducted a survey of medical libraries' use of NLM's CIP records. NLM staff assisted in tabulating the data. The results indicated that a significant majority of health sciences libraries use CIP data, primarily for the creation of permanent cataloging records.

Indexing. NLM's indexing activities include selecting the literature to be indexed; keyboarding the descriptive information and abstracts from the articles to be indexed; reviewing the accuracy of keyboarding and indexing; and editing and maintaining the citation databases to correct indexing errors and to identify citations to articles that have been subsequently retracted or corrected.

In FY 1988, the Literature Selection Technical Review Committee (LSTRC--see Appendix 6), an official NIH Advisory Committee, replaced the consultants who had previously advised NLM on the selection of journals to be indexed. During the year, 249 journals were reviewed by the LSTRC or the

previous group of journal consultants and 74 of them received an indexing priority sufficiently high to warrant immediate inclusion in MEDLINE and *Index Medicus*. The LSTRC also reviewed a report from professional societies in family medicine regarding the most important journals in that specialty and selected two titles for indexing based on the societies' recommendations. During FY 1988, NLM established procedures to obtain several subject reviews of journals from appropriate professional societies each year. The Library also conducted an internal review of MEDLINE coverage of biotechnology journals.

A total of 329,019 articles were indexed for MEDLINE in FY 1988. Abstracts were entered into MEDLINE for 197,674 or 60 percent of these. Of the 313,963 articles indexed for *Index Medicus*, 14.7 percent were indexed by NLM staff; the remainder were indexed either directly by International MEDLARS Centers; through arrangements made by International MEDLARS Centers with U. S. commercial firms; or by NLM contractors.

NLM continues to update MEDLARS citations to articles that have been retracted or corrected in published errata notices. In FY 1988, information about 12 retracted articles and 1415 errata notices were added to MEDLARS files.

During FY 1987, NLM reviewed its policies for assigning title abbreviations to indexed journals to bring them into closer conformance with national and international standards. As a result, many title abbreviations in MEDLINE will be modified before the 1989 database becomes available.

Network Services

NLM's services to local and remote users include: (1) disseminating authoritative cataloging and indexing data in publications, machine-readable formats, and an online retrieval service; (2) providing reference assistance in response to visitor, telephone, and written requests; (3) providing documents or copies of documents to health professionals and researchers as a backup to other U. S. biomedical libraries; and (4) directing the Regional Medical Library Network, which links U. S. biomedical libraries in an effort to make quality information service readily available to health professionals irrespective of their geographic location.

Publications. NLM has been distributing printed catalogs and indexes for more than 100 years, and such publications remain an important vehicle for worldwide dissemination of the Library's authoritative descriptions of the biomedical literature. In FY 1988, NLM produced issues of more than 30 recurring indexes and catalogs, including *Index Medicus*, the *National Library of Medicine Current Catalog*, the *Bibliography of the History of Medicine*, and microfiche tools such as *Health Sciences Serials*. Some of the special subject bibliographies are produced in cooperation with other organizations and distributed by them.

In addition to its catalogs and indexes, NLM also publishes a quarterly *AIDS Bibliography* and a series of special bibliographies on topics of current interest, formerly known as Literature Searches and as of January 1988 entitled *Current Bibliographies in Medicine*. *Current Bibliographies* are frequently produced in cooperation with other NIH organizations as background for NIH Consensus Development Conferences. Topics covered in FY 1988 included: pregnancy in older women; adolescent suicide; pain, anesthesia, and analgesia in common laboratory animals; and urinary incontinence in adults. In January 1988 the *AIDS Bibliography* and *Current Bibliographies in Medicine* became available from the Government Printing Office.

In addition to these two series, the Library occasionally produces more extensive special bibliographies, often in conjunction with a symposium or event held at NLM. Among such publications in FY 1988 was a heavily requested

bibliography on physical fitness and sports medicine.

The Library also produces a variety of special brochures, posters, publications, and training materials. In FY 1988, the Library updated *The Basics of Searching MEDLINE* manual and the MEDLINE pocket card and published a new MeSH pocket card for use by online searchers.

Machine-Readable Databases. To provide broader access to its authoritative data, NLM leases complete databases and subsets in machine-readable form to other organizations. Organizations leasing NLM data include commercial database vendors, international MEDLARS centers, academic health science centers, and a variety of other members of the information industry. In FY 1988, NLM established tape license agreements with 12 new institutions and distributed more than 3,000 tapes of various databases. The Library expanded the amount of NLM data available in the USMARC (Machine-Readable Cataloging) format by making the MeSH file available in the USMARC Format for Authority Data for the first time. Twelve institutions have requested test tapes of MeSH in this format. The experimental agreements with commercial organizations for the redistribution of MEDLINE on compact disk were replaced with standard license agreements as NLM established its charges for this method of redistribution of MEDLINE data. (See section on Outreach in the chapter, "1988 Special Initiatives" for discussion of CD-ROM.)

Online Services. NLM currently provides online access to 29 MEDLARS databases. The total annual usage of the MEDLARS system at NLM was 312,320 connect hours, an increase of 10.5 percent from FY 1987. This figure does not reflect use of MEDLARS data on the computer systems of foreign and domestic licensees.

The number of online codes authorized to use the MEDLARS system continues to grow rapidly. At the end of FY 1988, there were 20,846 active codes, an increase of 53 percent from the end of FY 1987. FY 1988 was the first year of NLM's new student code policy which reduced the charge for student access to NLM's online services. A total of 2,678 institutional and individual student codes were assigned during the year. Seventy-two percent of all users who received codes in FY 1988 indicated an intent to use the GRATEFUL MED microcomputer front-end package to access NLM's online services. A description of GRATEFUL MED's role in NLM's outreach program is in the chapter on special initiatives.

During the past year, several important enhancements were made to NLM's online services. AIDSLINE, a database devoted specifically to the literature about acquired immunodeficiency syndrome (AIDS), joined the family of MEDLARS databases in July 1988. Initially composed of MEDLINE citations, AIDSLINE will be expanded to include records from other databases in FY 1989. In April 1988, NLM increased the MEDLINE update schedule from once to twice each month to provide more rapid access to the current literature.

In FY 1988, 918 people, primarily search intermediaries, attended online searching classes at 46 locations throughout the country taught by NLM and three Regional Medical Libraries.

Reference Services. NLM received 76,107 requests for reference assistance in FY 1988, 64 percent from onsite users and the remainder in telephone calls or correspondence. Many people who call or write to NLM are unaware of biomedical information resources available locally or of the various Federal information clearinghouses that serve the lay public. In addition to providing some information to answer the requestor's immediate question, the NLM Reference Staff also directs people to other agencies that have pertinent information. This year NLM prepared a Guide to Locating Patient Education Audiovisual Materials to assist the many requestors seeking these materials. NLM staff also began work

with a contractor to develop an expert system to help reference librarians in locating answers to questions about health statistics.

NLM's onsite reference services were improved in several ways. GRATEFUL MED was installed for onsite users as the interface to NLM's two catalog databases, CATLINE® and AVLINE, to DIRLINE (Directory of Information Resources Online), and to REFLINE, a special MEDLINE subset corresponding to the journals shelved in NLM's main Reading Room. Onsite patrons may also search the full MEDLINE database through a fee-based GRATEFUL MED workstation or through free experimental versions of the GRATEFUL MED program. A series of "pathfinder" brochures were prepared to help onsite patrons find information in 52 biomedical subject areas. NLM's Learning Resources Center was redesigned to include additional workstations for use of computer-based education packages and half-inch videocassettes.

Document Delivery. NLM's document delivery service is used by remote requestors as a back-up to the service provided by other libraries in the Regional Medical Library Network and also by onsite requestors to obtain items from NLM's closed stacks. In FY 1988, NLM received 204,484 interlibrary loan requests, 6 percent more than received in the previous year. Sixty-nine percent of the requests received by NLM came via DOCLINE. NLM fills requests for documents needed for patient care emergencies via telefacsimile transfer. In FY 1988, NLM received 521 emergency requests and processed all of them within 2 hours. The speed with which NLM handled all interlibrary loan requests improved substantially in FY 1988 to meet or exceed network standards. Eighty-seven percent of filled requests were processed within 4 days; 80 percent of unfilled requests were processed within 7 days. This improvement was possible because of changes in service policies for onsite users.

In FY 1988, NLM took additional steps to control the level of onsite requests for documents from the NLM collection. In February a PC-based patron registration and request logging system was implemented, and the Library implemented a 10-item-per-day limit for onsite stack requests. At the same time, NLM instituted a fee-based overnight photocopy service for high volume requestors. These changes were made based on an analysis of onsite requests which revealed that only 4 percent of NLM's onsite users requested an average of more than 10 items per day and that these high volume requestors were in the document delivery business. Exceptions to these policies can be made for scholars with special needs. As a result of the new policies, onsite requests for documents dropped 28 percent to a total of 205,586 and service time improved considerably. Seventy-seven percent of the onsite requests received in the second half of the fiscal year were processed within 30 minutes.

In FY 1988, NIH entered into a new agreement with a commercial company to furnish photocopiers for use by NLM's onsite users. The agreement specifies photocopiers that are less damaging to library materials and provides improved cash card copying facilities for users.

Regional Medical Library Program. The purpose of the Regional Medical Library Network is to improve and equalize access to medical information throughout the United States by linking health professionals and researchers to the resources they need irrespective of their geographic location. The network includes health sciences libraries of all sizes in all parts of the country. In each of seven multi-state regions, NLM has contracted with a distinguished medical library to coordinate a regional document delivery program, develop outreach services to health professionals in areas without adequate library services, promote resource sharing among health sciences libraries, encourage and support the use of online services within their regions, and foster the development of innovative

services to health professionals.

The 7 Regional Medical Libraries (RMLs) are supported by more than 120 large resource libraries, generally in medical schools, and many hospital and special libraries, individually and in effective consortia. In FY 1988, a formal network membership program was begun; 2831 health sciences libraries have so far applied for and been granted network membership. NLM's Regional Medical Library Program Office provides national coordination for the network. The Regional Medical Libraries:

1. Greater Northeastern Regional Medical Library Program (GNRMLP)
The New York Academy of Medicine
East 103rd Street
New York, New York 10029

2. Southeastern/Atlantic Regional Medical Library Services
University of Maryland
Health Sciences Library
111 South Greene Street
Baltimore, Maryland 21201

3. Greater Midwest Regional Medical Library Network (GMRMLN)
University of Illinois at Chicago
Library of the Health Sciences
P. O. Box 7509
Chicago, Illinois 60680

4. Midcontinental Regional Medical Library Program (MCRML)
University of Nebraska
Medical Center Library
42nd and Dewey Avenue
Omaha, Nebraska 68105-1065

5. South Central Regional Medical Library Program (TALON)
The University of Texas
Southwestern Medical Center at Dallas
5323 Harry Hines Boulevard
Dallas, Texas 75235 9049

6. Pacific Northwest Regional Health Sciences Library Service (PNRHSLS)
Health Sciences Library and Information Center
University of Washington
Seattle, Washington 98195

7. Pacific Southwest Regional Medical Library Service (PSRMLS)
Louise Darling Biomedical Library
University of California
10833 Le Conte Avenue
Los Angeles, California 90024-1798

The current RML contracts allow for a series of enhancement projects to be awarded at intervals throughout the 5-year contract period. These projects include investigations of the information needs and information seeking behavior of health professionals, pilot development of new information services, tests of new technologies or procedures to improve health information processing and other similar activities. New projects funded in FY 1988 include: an assessment of the impact of exhibits at regional and state health professional meetings as an outreach mechanism and, in West Virginia, a pilot project to introduce health professionals to Grateful Med.

Special Onsite Programs.

In addition to the reference and document delivery services provided to onsite patrons, NLM offers a variety of special programs and services for people who come to the Library in Bethesda, including guided tours and briefings on NLM's services and operations, and historical exhibits and symposia.

The Library also has a Visiting Historical Scholar program and offers a one-year onsite training program for library school graduates with potential for successful careers in health sciences information.

Public Tours and Briefings. Each year, the Library hosts many visitors from across the United States and around the world. In FY 1988, LO staff conducted 145 regular tours for a total of 461 visitors. More than 1,300 people (134 groups) received special orientation programs and tours arranged by the Office of Inquiries and Publications Management (Office of the Director). NLM staff also arranged special briefings on library programs and services for many individual visitors.

Historical Programs. The FY 1988 Visiting Historical Scholar was Gerald Geisen, Ph.D., Professor in the Program in History of Science and the History Department at Princeton University. Each year, under the Visiting Scholar Program, a recognized scholar is competitively selected to spend 6 to 12 months at NLM to engage in research that will use the Library's collections, to give one or more public presentations, to assess segments of NLM's historical collection, and to consult with staff in his or her areas of expertise. Dr. Geisen used NLM's collection in his work on an interpretive history of modern biomedicine in Western Europe and the United States. He presented a public lecture on "Pasteur and the Ethics of Biomedical Research" based largely on manuscript materials such as Pasteur's private laboratory notebooks and assisted the Library in assessing its Pasteur manuscript materials.

In FY 1988, NLM's History of Medicine Division prepared several special exhibits, presentations, brochures and other materials, some in conjunction with the NIH Centennial. Major lobby exhibits were mounted on "Blacks in Medicine: The Institutional Perspective," in cooperation with NLM's EEO Advisory Committee, and "A Century of American Dental Research," in collaboration with the National Institute of Dental Research. LO staff, working with cosponsoring institutions, contributed to the arrangements for three successful symposia held at the NLM in FY 1988: "The Image of Health Professionals in the Popular Arts," "Physical Fitness and Sports Medicine," and the "History of Medical Informatics." Individual staff members continued their research using NLM's historical collections. Staff research was published in several publications and presented at invited lectures throughout the year.

NLM Associate Program. The NLM Associate Program is a one-year competitive program that provides library school graduates an opportunity to learn about NLM's operations and those of other health sciences libraries, to use new information technologies, and to develop their skills by conducting special projects. Projects undertaken in FY 1988 included analyses of system records of actual GRATEFUL MED search sessions and the preparation of a traveling exhibit on the preservation of the biomedical literature. Associates also have an opportunity to visit the other national libraries and various types of health sciences libraries or information centers and to attend professional meetings. NLM staff members continue to attend portions of the Associates' formal curriculum.

Four Associates completed the 1987/88 program. Two were selected for positions at NLM and two chose positions in academic institutions. Seven new Associates, including one from Puerto Rico, began the program in September 1988. The NLM continued its practice of inviting faculty from three library schools to attend the initial orientation for the new Associates. The goal is to increase library school faculty understanding of the program so they can promote interest in it among qualified library school students and to gain information about the current composition of the student bodies in library schools and their job placement prospects.

Table 1
Growth of Collections

Collection	*Previous Total (9/30/87)*	*FY 1988*	*New Total*
Book Materials Monographs:			
Before 1500	568	0	568
1501-1600	5,715	7	5,722
1601-1700	10,013	24	10,037
1701-1800	24,240	34	24,274
1801-1870	39,764	40	39,804
Americana	2,337	0	2,337
1870-Present	493,581	14,941	508,522
Theses HMD	281,794	0	281,794
Pamphlets	172,021	0	172,021
Bound serial volumes	830,816	31,839	862,655
Volumes withdrawn	(32,750)	(1,598)	(34,348)
Total volumes	1,828,099	45,287	1,873,386
Nonbook Materials			
Microforms:			
Microfilm reels	37,711	4,781	42,492
No. of microfiche	195,682	12,330	208,012
Total microforms	233,393	17,111	250,504
Audiovisuals	45,477	1,096	46,573
Computer software	0	1	1
Pictures	75,842	231	76,073
Manuscripts	1,595,819	143,844	1,739,663

Table 2
Acquisition Statistics

Acquisitions	FY 1986	FY 1987	FY 1988
Current Serial Titles Received	22,621	22,293	20,726
Publications Processed:			
Serial Pieces	125,584	124,898	133,226
Other	27,264	23,696	20,101
Total	152,848	148,594	153,327
Obligations for:			
Publications	$2,318,192	$2,908,000	$3,495,123
Included for Rare Books	(92,813)	(115,455)	(156,446)

Table 3
Cataloging Statistics

Item	FY 1986	FY 1987	FY 1988
Completed cataloging			
Full	11,716	13,869	14,567
Limited	8,569	4,785	5,721
Total	20,285	18,654	20,288

Table 4
Bibliographic Services

Services	FY 1986	FY 1987	FY 1988
Citations Published*	316,585	326,162	329,019
For *Index Medicus*	297,772	298,160	313,963
Recurring Bibliographies	27	28	28
Journals Indexed for *Index Medicus*	2,740	2,786	2,855
Abstracts Entered	187,662	186,572	197,674

*Includes special list articles, audiotapes, and Health Administration citations

Table 5
Online Searches

DATABASES	FY 1986	FY 1987	FY 1988
AIDSLINE	.....	.....	2,977
AVLINE	13,277	11,357	11,937
BIOETHICS	5,997	7,410	7,888
CANCERLIT	54,876	58,066	54,759
CANCERPROJ®	2,337	1,162	.....
CATLINE	135,546	145,525	160,129
CCRIS	14,582	2,608	2,894
CHEMLINE®	27,056	26,725	24,907
CLINPROT®	3,394	3,044	2,956
DIRLINE	3,534	3,887	6,107
DOCUSER	.....	.....	973
HEALTH	108,719	119,426	121,589
HISTLINE®	4,842	4,555	4,131
HSDB®	32,375	22,407	31,976
INFORM	176	184	146
INTROTOX	282	146	43
INTROMED®	10,087	5,825	4,955
MEDLINE	1,442,598	1,722,711	1,895,591
MED83	269,614	422,022	526,338
MED80	313,112	291,216	276,753
MED77	133,060	136,132	140,990
MED75	83,168	80,049	16,018
MED72	.....	.....	75,518
MED71	56,845	60,846	15,731
MED66	46,223	50,848	64,423
MESH VOCABULARY	13,186	15,693	20,158
NAME AUTHORITY	3,473	3,214	3,120
PDQRS	25,994	32,791	44,822
POPLINE	20,058	21,085	20,849
REFLINE	.....	.....	31,967
RTECS®-ELHILL	10,658	8,938	2,703
RTECS®-TOXNET	.....	.....	13,693
SDILINE®	33,010	37,241	38,956
SERLINE	36,982	44,835	49,137
STORED SEARCH	95	95	83
TDB®-TOXNET	5,325	.....	.....
TOXLINE®	68,869	73,630	68,398
TOXBACK76	18,681	13,228	.....
TOXBACK65	13,395	9,388	.....
TOXLIT	.....	3,520	24,171
TOXLIT65	.....	1,439	8,742
YEAR86	.....	302	201
Total	3,011,426	3,441,550	3,776,729

Table 6
Offline Searches

DATABASES	FY 1986	FY 1987	FY 1988
AIDSLINE	.....	.....	5
AVLINE	194	178	208
BIOETHICS	30	27	34
CANCERLIT	5,676	5,272	3,726
CANCERPROJ	1	2	.....
CATLINE	329	343	517
CHEMLINE	31	.....	4
CLINPROT	.....	2	3
DIRLINE	1	1	2
HEALTH	12,765	11,596	11,173
HISTLINE	23	13	8
MEDLINE	14,098	10,871	8,960
MED83	17,380	18,376	13,862
MED80	21,739	16,582	11,014
MED77	14,073	10,730	7,332
MED75	11,137	7,606	1,320
MED72	.....	.....	3,141
MED71	6,650	4,979	871
MED66	4,481	3,227	2,757
MESH VOCABULARY	2	4	7
POPLINE	11,694	7,842	5,337
RTECS-ELHILL	37	11	.....
RTECS-TOXNET	.....	.....	3
SDILINE	244,165	238,172	231,269
SERLINE	1	1	3
TOXLINE	17,189	14,060	15,474
TOXBACK76	1,418	561	.....
TOXBACK65	1,280	516	.....
TOXLIT	.....	123	366
TOXLIT65	.....	110	312
Total	384,394	351,205	317,708

Table 7
Circulation Statistics

Activity	FY 1986	FY 1987	FY 1988
Requests received:	438,678	479,667	415,137
Interlibrary loan	153,797	192,559	204,484
Readers	284,881	287,108	210,653
Requests filled:	364,661	381,994	316,508
Interlibrary loan	119,591	135,883	143,151
Photocopy	110,379	124,821	131,870
Original	7,595	9,423	9,810
Audiovisual	1,617	1,639	1,471
Readers	245,070	246,111	173,357
Requests unfilled:	74,017	94,714	96,283
Interlibrary Loan	34,206	56,805	61,333
Referred	1,169	2,972	2,125
Returned	33,037	53,833	59,208
Reader service			
Returned-unavailable	39,811	37,909	34,950

Table 8
Reference Services

Activity	FY 1986	FY 1987	FY 1988
Reference section:			
Requests by telephone	25,744	25,883	26,429
Requests by mail	1,104	898	743
In-person requests	44,444	43,185	48,935
Total	71,292	69,966	76,107

Table 9
History of Medicine Activities

Activity	FY 1986	FY 1987	FY 1988
Acquisitions:			
Books	296	162	125
Modern manuscripts	146,105	18,330	166,429
Prints and photographs	190	230	214
Processing:			
Books cataloged	313	150	442
Modern MSS cataloged	62,650	18,782	11,625
Pictures cataloged	995	38	138
Citations indexed	5,880	5,390	5,645
Pages microfilmed	134,546	21,836	48,774
Public service:			
Reference queries answered	4,560	5,512	10,077
ILL and pay orders filled	1,936	2,880	3,607
Reader requests filled	6,228	9,996	10,416
Pictures supplied	5,262	5,494	6,642

Specialized Information Services

Henry Kissman, Ph.D.
Associate Director

Background

Ozone. Radon. Acid Rain. The media bombards us with headlines on the environment. Society is worried about the pernicious effects of synthetic and natural chemicals more than it has been since the environmental decade of the 1970s. Government agencies are taking increasing measures to control hazardous waste sites and releases of pollutants into the environment. The public is demanding notification of chemicals in its backyards and insisting on measures to insure safety. Citizens are involved as never before in seeking to limit their exposure to natural pollutants and stem the tide of man-made chemicals into their neighborhoods. The chemical "right-to-know" movement has extended from the worker to the public. Industry has been responsive to many of these demands and agreed to share information for safeguarding the public health. Industry, government, and the general public are working together to seek solutions to environmental problems. The more information is made available, the easier it will be to plan for and respond to chemical accidents.

For more than 20 years, the Toxicology Information Program (TIP) of NLM's Specialized Information Services Division (SIS) has been involved in the battle for environmental safety and health. TIP has done this as an information provider. Responsible industry has always monitored itself and provided research and controls to prevent chemical disasters. Federal, State, and local legislatures have worked through legal and regulatory frameworks to insure chemical safety. TIP has supported and continues to support these groups and, increasingly, the public by a variety of information services and products, especially computerized databases.

SIS's long established TOXLINE database provides an enormous storehouse of references on the health and environmental consequences of hazardous substances. The newer and rapidly growing TOXNET® system has proven a successful approach to offering factual data about chemicals, their identity, safety and handling, toxicity, and environmental fate. TOXNET's Hazardous Substances Data Bank (HSDB) is being widely used in chemical emergency response situations, such as highway spills involving dangerous substances.

Currently SIS is developing a number of new files in collaboration with other Federal agencies, such as the Environmental Protection Agency (EPA). The Toxic Chemicals Release Inventory (TRI) databank, for instance, is being jointly developed with the EPA. This databank will contain names and addresses of industrial sites reporting releases of chemicals to the environment or their transfer to waste treatment sites. Specific amounts transferred or released will also be available. Mounting TRI on TOXNET will allow easy and flexible searching.

As concern about the environment widens, information needs increase. Federal agencies are looking upon TIP and the NLM computer systems as ideal vehicles to disseminate toxicological and environmental data. TIP welcomes this role and looks forward to retaining its strong ties with the scientific community while broadening its services to local governments and the public.

Databases under ELHILL

CHEMLINE (Chemical Dictionary Online) is an online chemical dictionary and directory file which allows users to identify chemical substances via nomenclature and other identifiers, and to formulate optimum search strategies for other NLM files. Each chemical record has pointers to other files in the ELHILL and TOXNET systems which contain information about that chemical substance. CHEMLINE is built and maintained with contract support from Chemical Abstracts Service (CAS) and AEPCO, Inc. It is updated every two months and regenerated annually. Originally implemented in January 1974 with about 59,000 records, the file now contains over 815,000 records of chemical

substances of biomedical or regulatory interest.

During FY 1988, the major effort which began in 1983 to diversify and augment the content of CHEMLINE continued. Enhancements were made in (1) coverage of the European spelling of many chemicals, particularly drugs and pesticides, (2) tagging names to designate their appearance in an official national compendium, (3) greatly increased coverage of data from the EPA TSCA Inventory, and (4) addition of cross-references to "parent" records in certain salt and hydrate records.

TOXLINE (Toxicology Information Online) is an online bibliographic retrieval service produced by merging "toxicology" subsets from some 15 secondary sources, including Biological Abstracts, Chemical Abstracts, Government Reports Announcement and Index (report literature), International Pharmaceutical Abstracts, and MEDLINE. The recently reorganized TOXLINE and the two royalty-based files, TOXLIT and TOXLIT65, now contain some 2,500,000 records. This represents more than a ten-fold increase in the number of bibliographic records since the file was first made available by NLM in September 1972.

During FY 1988, the TOXLINE files were regenerated and restructured into a set of nonroyalty- and royalty-based files. TOXLINE contains nonproprietary data from 12 sources and consists of 900,000 bibliographic records. This file was regenerated in December 1987 in order to update the MeSH vocabulary used to index the portion of the file derived from MEDLINE. The royalty-based files, TOXLIT and TOXLIT65, contain more than 1.5 million citations obtained from Chemical Abstracts, Biological Abstracts, and International Pharmaceutical Abstracts. Plans call for restructuring the TOXLINE files in January 1989 into four files, splitting the present TOXLINE into a front and back file, TOXLINE65 which will then contain all pre-1981 citations. At this time, SIS will also move the components from Biological Abstracts and International Pharmaceutical Abstracts back into the TOXLINE files. This is possible because flat license fee contracts have been negotiated with these suppliers, without additional royalty charges based on file use.

One new subfile was added to TOXLINE during FY 1988. This was the Toxic Substances Control Act Test Submissions (TSCATS), a collection of industry submissions to the Environmental Protection Agency (EPA) under the provisions of TSCA. Regular updates to this subfile are anticipated as new submissions are made to EPA.

DIRLINE (Directory of Information Resources Online), is an online directory of organizations willing to provide information in their subject areas in response to inquiries. This database assists MEDLARS users by providing an alternative resource for information needs not met by bibliographic or factual databases. DIRLINE uses data from (1) the Library of Congress National Referral Center database (13,992 multidisciplinary records); (2) the DHHS Office of Disease Prevention and Health Promotion's National Health Information Center database (1050 records of health-related organizations); (3) a list of poison control centers compiled and maintained by the publication *Emergency Medicine* and the American Association of Poison Control Centers (104 records indicating state designated or certified centers); (4) the DHHS Alcohol, Drug Abuse and Mental Health Administration's National Clearinghouse on Alcohol and Drug Information (49 state centers); (5) the NLM's History of Medicine Division (22 records of libraries with strong collections in the history of medicine added to the database during 1988); and (6) the National Center for Education in Maternal and Child Health (365 records dealing will all aspects of the health of mothers and their children, added to the database during 1988). Plans are under way to add other subfiles in areas of interest to MEDLARS users such as AIDS and biotechnology.

Version 3 of Grateful Med, released in 1988, includes access to DIRLINE, facilitating use of the database by a larger segment of the user community.

Microcomputer-based User Aids

During FY 1988, SIS developed MEDTUTOR, one of a series of PC-based, self-instructional tools for selected MEDLARS databases. MEDTUTOR is an interactive, microcomputer-based training program designed to teach medical and health professionals, as well as librarians and information scientists, how to use MEDLINE effectively. It may be used in place of formal training, as a precursor to or a refresher following formal training, or for review of a particular concept.

SIS also released CHEMLEARN Version 2.0, a microcomputer-based training program for CHEMLINE that incorporates many new features and enhancements. Included in these are optional SUMMARIES for every topic, optional HELPS for every user interaction, a scroll feature in the DICTIONARY and MAP, and a print feature for the DICTIONARY, MAP, and SUMMARIES.

Additionally, SIS released an updated version of the DEMO DISK which provides an overview and interactive simulated searches for the CHEMLINE, TOXLINE, DIRLINE, RTECS, CCRIS, and HSDB files.

TOXNET and its FILES

With funding authorized under the Superfund Amendments and Reauthorization Act (SARA) of 1986, the TIP has been carrying out assorted information activities for the Agency for Toxic Substances and Disease Registry (ATSDR). These activities include file building and the creation of improved methods of access to information resources in the areas of hazardous wastes and emergency response. The continued development of TOXNET, an integrated online search system, and the enhancement of its Hazardous Substances Data Bank (HSDB) have been predominant TIP activities related to this legislation.

During 1988, an improved version of the TOXNET Gateway was implemented. The Gateway now allows users to switch to the PDQ file as well as files within the ELHILL® systen; and offers a simplified logoff procedure from any file. Also, because of the Gateway's popularity, additional telecommunication ports have been added to allow access to more users simultaneously. Online connect hours reached a new high for TOXNET and Gateway usage.

HSDB usage continued at a high level throughout the year. With some 4200 chemical records and a file structure of 150 data fields, HSDB contains extensive information on the toxicity of chemicals, their safety and handling, environmental fate and exposure potential, and standards and regulations. HSDB has been increasingly applied to chemical emergency response situations and even used in a simulation exercise by the Maryland Institute for Emergency Medical Services System. New HSDB Review Status Tags permit users to search more precisely for the degree of peer review of HSDB data statements. Additional software features facilitate staff entry of EXPRESS data culled from current literature, thus keeping the file very much up to date. An agreement has been reached with the DuPont Company under which they will provide toxicity summaries for HSDB. A cooperative venture with MICROMEDEX, Inc., will result in HSDB being augmented with medical treatment data from that firm's widely used POISINDEX database.

RTECS (Registry of Toxic Effects of Chemical Substances), another online data retrieval service, is based upon the National Institute for Occupational Safety and Health file by that name which NLM restructures for online searching. In December 1987, the RTECS file was made available on NLM's TOXNET system, with a newly structured unit record differing somewhat from the version previously available on NLM's ELHILL system. User response to the new RTECS and to the capabilities that the

TOXNET search system provides have been favorable. In March, the ELHILL version was removed permanently. SIS has continued with the project, begun in 1987, to enrich the RTECS file with Chemical Abstracts Service (CAS) Registry Numbers for records lacking them. These identification numbers are crucial for unequivocal data retrieval and for matching RTECS records with those in other files. This project has resulted in approximately 20,000 enhanced RTECS records. RTECS now contains more than 95,000 records.

Access to the Chemical Carcinogenesis Research Information System (CCRIS) on TOXNET has been widely appreciated within the cancer research community. This National Cancer Institute file contains carcinogenicity, mutagenicity, and tumor promotion test results. Several significant enhancements have been implemented in the past year. These include making the extensive references fully searchable and creating more online explanations for the useful CCRIS controlled vocabulary.

The Chemical Directory File (CDF) is an online chemical dictionary and locator file being developed for TOXNET. The first version of the CDF will contain about 150,000 chemical records. These records will consist largely of identifying data such as chemical synonyms and CAS Registry Numbers. Chemical records will also contain "locators", indicating both other TOXNET files containing data on the chemicals and regulatory agency lists on which the chemicals may appear. In 1988, the CDF unit record was designed, data was formatted, and test files were made available. To augment drug coverage, an agreement was reached with the United States Pharmacopeial Convention to add its data to CDF. Other government files containing chemical nomenclature data were also readied for CDF. Containing strictly nonroyalty based data, CDF access charges will be equal to those of all other TOXNET files.

The Environmental Mutagen Information Center (EMIC) and the Environmental Teratology Information Center (ETIC) are bibliographic databases produced by the Environmental Mutagen, Carcinogen, and Teratogen Information Program of the Oak Ridge National Laboratory. EMIC contains references to articles on the mutagenic activity of chemicals and other agents. ETIC's scope covers teratology and developmental toxicology. These databases are funded by the Agency for Toxic Substances and Disease Registry, the Environmental Protection Agency, and the National Institute of Environmental Health Sciences. In FY 1987 these agencies asked the NLM to assume the management of the databases. EMIC and ETIC will be built, maintained, and made publicly available on TOXNET early in 1989.

NLM and the Environmental Protection Agency signed an interagency agreement to develop and maintain a publicly available Toxic Chemicals Release Inventory (TRI) databank on TOXNET. TRI is mandated by the Emergency Planning and Community Right-to-Know Act, Title III, of the Superfund Amendments and Reauthorization Act of 1986. This Act requires certain businesses to submit to EPA, data on their releases of any of over 300 hazardous chemicals, provided a certain threshold amount is exceeded. These releases may be routine or accidental releases to the air, water or land. TRI will contain names and addresses of all facilities reporting chemical releases or transfers to waste treatment sites, with specific amounts released or transferred. EPA estimates some 90,000 submissions in the first reporting year. SIS has already completed the TRI Unit Record and developed a detailed schedule covering all phases of the TRI project. EPA anticipates significant usage of this file not only by scientists, regulators, and the health care community, but also by the public at large. TRI is scheduled to be available for searching by April 1989.

Agreements have been signed for a number of other files to become available on TOXNET in the coming year. These are EPA's Integrated Risk

Information System (IRIS), EPA's GENE-TOX database, and a file to contain the summaries of the Toxicological Profiles prepared by the Agency for Toxic Substances and Disease Registry in response to SARA mandates.

User Support Services

User support for all online files is a continuing TIP function. User Guides for the CHEMLINE, TOXLINE, RTECS, HSDB, CCRIS, and DIRLINE files were updated and made available as part of NLM's Online Services Reference Manual. Updated fact sheets for these files, the TOXNET system, and other related activities are routinely prepared. The TOXNET Brief Guide was reissued in May 1988. The Program continued to provide training for its online files both as a part of the MEDLARS Training Program and for other users at special training sessions and at professional meetings.

In addition, special training in the use of the toxicology files was provided in conjunction with the Agency for Toxic Substances and Disease Registry (ATSDR) to environmental health specialists from ATSDR and from selected state agencies. This program was conducted under NLM direction by the Oak Ridge Associated Universities in Oak Ridge, Tennessee. It is expected that the project will be expanded in FY 1989, with an additional program designed to train state health representatives to provide training for the use of the NLM toxicology files back in their own home states.

Microcomputer Workstation

In FY 1988, the Microcomputer Workstation and the Expert System for Chemical Emergencies projects were combined. SIS is collaborating with the ATSDR to build a portable, microcomputer-based facility that can provide assistance to emergency response teams in responding to hazardous chemical releases or spills. The operational prototype Workstation consists of a suite of existing and custom-written software modules designed to facilitate easy access by response team members to information important during emergencies.

The core modules of the Workstation are:

1. A CD-ROM-based database containing information on both hazard management and medical management.

2. A specialized database containing information from previous chemical emergencies.

3. A modified version of the Micro-CSIN software that includes capabilities to search remote online databases.

4. Access to National Weather Service weather information.

5. A report generation capability for editing, sorting, merging, and transforming retrieved data files.

The Workstation will be made available to selected State and county emergency response teams for testing and feedback.

Biotechnology

The Seminar Series in Biotechnology has been continued, with consistently excellent presentations by a variety of speakers, and continued favorable reception by the NIH community. Talks were given by Drs. Norman Anderson (LSB Corporation), Harold Morowitz (Yale), Douglas Brutlag (Stanford), Charles Gasser (Monsanto Company), Eric Lander (Whitehead Institute), Charles Cantor (Columbia), W. French Anderson (NHLBI/NIH), and Heiner Westphal (NICHHD/NIH). Video tapes of the talks are routinely being distributed to the Regional Medical Libraries and to NLM-sponsored Informatics Training Programs.

Assembly of the Directory of Biotechnology Information Resources is continuing, with the expectation that it will be publicly available in the winter of 1988. This Directory will serve as a "database of databases," guiding users to valuable resources in the field of biotechnology. It is planned that it will be accessible online in both the ELHILL and TOXNET systems. Possibly it will also be distributed on magnetic disk and in printed form. The file is being assembled under contract by the American Type Culture Collection of Rockville, Maryland.

At the request of the International Biotechnology Subcommittee of the Committee on Life Science, Office of Science and Technology Policy, SIS has convened a working group, with representation from the relevant major Federal agencies, in order to examine the desirability, requirements, and feasibility of assembling a Biotechnology Environmental Release Database. This would be a centralized file dealing with all issues that affect the environmental release of genetically altered organisms. This information is potentially useful both to the private sector and to various Federal agencies.

Information Services to Other Agencies

SIS provided information/data support on chemical substances to the ATSDR by building and maintaining data and information resources relevant to ATSDR's legislative mandate. These services also are supportive of the government and nongovernment communities with related mandates to protect the environment and the public health.

NLM sources of relevant data and information include the Chemical Carcinogenesis Research Information System (CCRIS) sponsored by the National Cancer Institute, Toxic Chemicals Release Inventory (TRI) sponsored by the Environmental Protection Agency, and the Hazardous Substances Data Bank (HSDB), in part sponsored by ATSDR.

SIS chaired the Subcommittee on Information Coordination of the Department of Health and Human Services' Committee to Coordinate Environmental Health and Related Programs and also represented the Library on several of its other Subcommittees. Resources have been made available by the Committee's Council and the Chemical Manufactures Association for the development of experimental indicators capable of identifying the completeness of documentation of published scientific articles. Such indicators are to allow users of computerized information resources to prioritize their interests in material retrieved from these files. The Subcommittee also has Council support for the development of a Directory of Risk Assessment Projects conducted or sponsored by DHHS Agencies represented on the Committee.

Through the Toxicology Information Response Center®, maintained by SIS at the Oak Ridge National Laboratory, information support services are supplied to the Food and Drug Administration, the Department of the Army and to other Federal and State agencies, as well as to the public at large.

Lister Hill National Center for Biomedical Communications

Daniel Masys, M.D.
Director

The Lister Hill National Center for Biomedical Communications (LHNCBC) was established by a joint resolution of Congress in 1968. The Center serves as the intramural research and development division of the National Library of Medicine. LHNCBC research programs apply state-of-the-art computer and communications technologies to the management of biomedical knowledge. Such knowledge can take the form of procedural rules found in expert systems, information in factual databases such as molecular sequence data, as well as signals, images and sound. LHNCBC programs create innovative methods for acquiring, storing, retrieving, analyzing, and presenting information to biomedical researchers and health care professionals.

The Center pursues research projects with long-term potential for improving patterns of information processing, analysis, and retrieval on a national scale. Artificial intelligence for medical decision assistance, molecular biology information systems, document image processing, and videodisc-based instruction are important areas currently under investigation by Lister Hill Center Staff. A significant number of projects involve long-term research collaborations with other NLM programs. Those and other projects include collaboration with institutions in biomedicine and medical informatics with parallel interests.

Organizational Structure

A Director and Deputy Director provide oversight and management to the Center's activities. There are six branches:

- National Center for Biotechnology Information Branch
- Computer Science Branch
- Information Technology Branch
- Communications Engineering Branch
- Audiovisual Program Development Branch
- Educational Technology Branch

During 1988 Dr. Dennis Benson of the LHNCBC staff was selected as Chief of the new National Center for Biotechnology Information Branch. This branch was formed around project staff conducting research in molecular biology information systems and followed Congressional authorization of funds to support an expanded program to develop and foster new systems for coping with the increasing amounts of biotechnology information resulting from genetic research.

A Board of Scientific Counselors (BoSC) reviews the quality and contents of the intramural research programs within NLM, emphasizing those of the LHNCBC. It is composed of scientific and technical experts (see Appendix 4 for a list of members) who are prominent leaders in the fields of medicine, computer science, engineering, and health professions education. The BoSC meets twice yearly to review and make recommendations on the LHNCBC programs to the NLM Director and the Lister Hill Center Director.

Research Program Overview

The research and development programs of the LHNCBC fall into 3 categories:

1. Computer and information science as applied to the problems of the Library, of biomedical research, and health care delivery;
2. Biomedical image engineering, including image acquisition, processing, storage, retrieval, and communications; and
3. Use of computer and image technologies for health professions education. Within each of these major programs, there are a number of continuing projects.

Computer and Information Science

Expert Systems Program. A research program in artificial intelligence concentrating on expert systems

was established at LHNCBC in 1984. Expert systems are computer programs which combine knowledge of a particular subject area with inferencing mechanisms enabling them to use this knowledge in problem-solving situations. Expert systems can be categorized in two primary types: systems to assist experts in coping with conditions of information overload, and systems for the transfer of expertise. The latter systems can amplify the accessibility of specialist-level expertise by encapsulating portions of this expertise and making it available when the human specialists are not. Systems of both types are under active development at the Lister Hill Center.

One focus of the Expert Systems Program is the continuing development and evaluation of the AI/RHEUM consultant system in rheumatology, one of the world's largest medical artificial intelligence systems. AI/RHEUM is the best known of a series of knowledge-based medical consultant systems using the criteria table form of knowledge representation pioneered by NLM researchers. The power, simplicity, and flexibility of this representation are augmented by a wholly new expert system shell written at NLM expressly for criteria-based reasoning systems. The new shell, called CTX for "Criteria Table Expert," runs on 80286 and 80386-class microcomputers and builds on all the features for which AI/RHEUM is notable, including direct point-and-click mouse access to information from four knowledge sources--text definitions; videodisc images; the disease criteria tables which are the foundation of its medical knowledge base; and GRATEFUL MED for automated dial-out, logon, searching and downloading from NLM's MEDLARS family of databases without leaving the running rheumatology consultant program. With these capabilities, the Lister Hill Center continues at the forefront of an encouraging national trend away from expert systems in isolation and toward systems having explicit linkages to useful information in other forms wherever it may reside.

In its current state, the AI/RHEUM diagnostic system contains in its knowledge base information on 32 rheumatologic diseases. It reasons from 913 patient findings (basic information such as signs, symptoms, laboratory tests, and radiographic observations) through 726 intermediate hypotheses to these 32 disease conclusions. It has several hundred text definitions (the "Tell Me More" knowledge source) available in a fraction of a second to explain those patient findings which might not be familiar to its intended users. In addition, the system offers direct access to a "Show Me More" videodisc image bank illustrating specific rheumatologic findings. The first of the AI/RHEUM videodiscs contained about 1,900 images. Work is now nearly complete on a new rheumatology videodisc with almost 6,000 images and several motion sequences illustrating patient observations difficult to convey in still frames.

The evaluation of medical expert systems such as AI/RHEUM is a difficult problem for which no generally accepted paradigm has yet been developed. Members of the Expert Systems Program have with other NLM staff and with nationally known evaluation specialists begun to develop a general methodology for the evaluation of medical expert systems. AI/RHEUM is being used as the specific vehicle for the testing of this methodology at multiple clinical sites in an NIH-funded evaluation program of several years' duration. Since the robustness of the consultant system in the face of potentially inaccurate observations given it by users is a legitimate concern in validation, means for the automated perturbation of stored data in exploring such "brittleness" issues are being developed.

The Expert Systems Program also works with knowledge-based consultant systems in other areas of medicine, such as AI/COAG, described in last year's *NLM Programs and Services*. The potential utility of the Hypercard environment on Macintosh II workstations is now being explored for the expansion of AI/COAG. In other areas, Expert

Systems Program staff are continuing to develop a prototype system to advise response teams in hazardous substances emergencies. They are also involved in the start-up phases of a "cataloger's assistant" system to assist in the NLM cataloging process for new acquisitions and of an "expert searcher" system which will perform some of the functions of an expert medical reference librarian assisting a user in the formulation of queries for MEDLARS searches.

Members of the Expert Systems Program in FY 1988 completed two updates of an interactive videodisc exhibit on "Artificial Intelligence in Medicine," produced with LHNCBC's Audiovisual Program Development Branch last year and described in the 1987 *Programs and Services*. This exhibit, one component of a larger exhibition called "The Age of Intelligent Machines" opened at the Museum of Science in Boston in January 1987. It has spent three-month periods there and subsequently at four science museums around the country. The exhibit has also appeared at four national conferences by invitation and has been installed in a public area for use by visitors to the NLM. It will appear at three more museums of science during FY 1989. Expert Systems Program staff during FY 1988 also completed a second interactive InfoWindow-based presentation of a more general nature: a touchscreen version of the video introduction to NLM, "Communicating for Health."

The dissemination of information on artificial intelligence in medicine has been further addressed by another collaborative effort with LHNCBC's Audiovisual Program Development Branch, a series of brief (10-15 minutes) videotape segments on medical expert systems. These taped video productions help to explain artificial intelligence research in presentations which include statements of purpose and function by the system developers themselves. When appropriate, they use electronic graphics to illustrate the reasoning process of the system being presented. The tapes are available on interlibrary loan through the Regional Medical Library network. The series will be expanded in FY 1989.

Automated Classification and Retrieval Program (ACRP). The objectives of this program are to conduct both basic and applied research leading to the development of automated systems for representing, identifying, and retrieving relevant information from biomedical documents. Current work includes the development of an expert system to assist in the process of indexing the biomedical literature (MedIndEx), the development of a natural language understanding system, and the exploration of issues in the mapping and merging of thesauri.

(1) Natural Language Systems Project. Natural Language Systems activities focus on research questions which lie at the intersection of the fields of computer science, information science, and linguistics. The research is based on the hypothesis that natural language processing systems which combine sophisticated linguistic analysis with structured domain knowledge will lead to improved representation and retrieval of biomedical information.

A major emphasis of the project has been the development of SPECIALIST, an experimental system for parsing, analyzing, and accessing biomedical text. The parsing system includes morphological, syntactic, and semantic rules. The parser requires an extensive and well-specified lexicon with explicit links to a knowledge base of biomedical concepts. Project staff continue to expand the lexicon, which includes both general English lexical items and lexical items specific to the biomedical domain. Each lexical entry encodes syntactic and semantic information. The syntactic and semantic rules then use this information as they build structured representations of the sentences in a text. Work has begun in the design and development of a network of biomedical concepts based on NLM's Medical Subject Heading (MeSH) hierarchy.

The Natural Language Systems project has benefited in a number of ways from the rich source of information offered by MEDLINE, NLM's bibliographic database. MEDLINE citation records include the title, an abstract when available, author and journal names, and a small set of MeSH terms under which the article has been indexed by expert indexers. A set of programs for processing sample texts from the MEDLINE database gives syntactic, morphological, and word-level information about the language of the biomedical domain. The MeSH vocabulary, which is organized in a hierarchical structure, provides important information about the domain itself. This structure is currently being modified and will be tested for its effectiveness as a domain model for the natural language understanding system.

The development of the SPECIALIST system has led to investigations in a number of additional areas. Work has focused on the research use of machine-readable sources of information whenever these are available. In particular, part of the research effort has involved the processing and interactive use of machine-readable dictionaries. Work continues to develop methods for accessing and manipulating the information encoded in these sources. Staff recently conducted an experiment involving the analysis of the semantic structure of neoclassical compounds. The results of this experiment have led to an evaluation of the role that morphological analysis plays in the automated analysis of biomedical text.

Dr. Alexa McCray participates in the work of the Unified Medical Language Systems project. She recently collaborated with a former NLM Associate, Zoe Stavri, in a set of experiments to assess the relative difficulty of converting the language of search requests to appropriate MeSH statements. A large number of search request forms submitted by health professionals to the MEDLINE database was collected and analyzed. The results of the analysis have direct implications for the development of automated or semi-automated systems which attempt to interact directly with end users.

(2) MedIndEx Project. Research on the MedIndEx System, described in last year's *Programs and Services*, has proceeded in two areas: the functionality of the user (indexer) interface, and development of the knowledge base frames and the rules for generating the MeSH indexing terms. A new interface features multiple window displays; mouse interaction; and selection from pop-up menus, menu bars and active regions in the windows. New versions of the System Design Document and User Manual have been prepared and included in a new interim LHNCBC/NTIS Technical Report. This documentation reflects the upgrading of the user interface and contains many figures illustrating the screen during interaction with the system. The knowledge base used by the system has been augmented and numerous additions have been made to the rules which produce indexing frames and generate the appropriate MeSH index terms. MedIndEx Project staff are preparing the prototype for testing in collaboration with the Indexing Section of NLM's Division of Library Operations.

Biotechnology Information Program. The Lister Hill Center's involvement with biotechnology information is described in the first chapter of this report, "1988 Special Initiatives."

Online Reference Works. The Online Reference Works (ORW) program addresses the issues of how to use most effectively the extensive, published body of medical reference works in an online, interactive manner and how to aid in the scholarly process of text creation and maintenance. An objective of the program has been to define and prototype a "scholar's workstation" that can serve as an integrated information resource for both the creation and the retrieval of reference works.

The platform for research in this program has been an experimental text retrieval system known as IRX (Information Retrieval Experiment). IRX

supports Natural Language Query (NLQ) searching of databases (e.g., the full text of *Mendelian Inheritance in Man* (MIM) by Dr. Victor A. McKusick, discussed below) providing a ranked output of search results to the user. It also allows the explicit use of Boolean combinations of terms where required or preferred. It is presently providing dial-up access via Telenet to OMIM (online MIM) at The Johns Hopkins University by an international community of biotechnology researchers with support from the Howard Hughes Medical Institute (HHMI), and is a key element in the National Biotechnology Information Center Program. Access to IRX is available via standard terminals, IBM PC-compatible computers, and sophisticated Sun Workstations.

There are several salient areas of IRX development, that while general in scope, are particularly critical to planned efforts at NLM and are to be addressed during the coming year. Primary to these is the evolution of IRX to support object-oriented data structures and real-time updates. Object-oriented data structures are dictated by the need to support many different types of retrieval objects in a concerted manner; e.g., text, computer-generated graphics, videodisc graphics (still and motion), sound, numeric data, etc. Real-time updates have been indicated by experience to be important on two accounts: 1) to insure currency of information, and 2) to reduce the overhead of manual database maintenance.

Within the ORW program, the Lister Hill Center's Information Technology Branch, in collaboration with Hopkins's Welch Medical Library, has continued efforts relating to MIM and has initiated a new effort targeted towards extending the developing paradigm to more generalized reference works. Among these efforts are the completion of a videodisc on skeletal dysplasia and the introduction of a facility for online annotations or marginalia. The latter promises to provide a major path of communication between online users and the editors/authors of online texts. The experience with MIM has proved highly informative and successful. Yet MIM represents a special, and in many aspects limited, case of medical reference works; it has a single author/editor, linear text structure, and no graphics or tables. The new effort that has been initiated explores the requirements of more generalized reference texts and is utilizing the work *Principals of Ambulatory Medicine*, edited by Barker, Burton, and Zieve. The characteristics of this work that recommend it as a research prototype include: multi-author (over 60), multi-editor, hierarchical text (105 chapters), tables, line-drawings, and images.

Generalized Courseware Delivery System Support. The Information Technology Branch staff have also explored the use of PC-based relational database systems in the development of GCDS (Generalized Courseware Delivery System) for the delivery of computer- and videodisc-based educational materials. Included within GCDS are tools for creating overlay graphics that may be stored within the relational database. This effort is an outgrowth of software developed for the Online Reference Works project.

Biomedical Image Engineering

This research area concentrates on electronic imaging technology for the capture, storage, processing, online retrieval, transmission, and display of biomedical documents and medical imagery. Topics of concern include image compression, image enhancement, image understanding, pseudo-gray-scale rendition, image transmission and networks, omnifont text recognition, and man-machine interface design. Research is under way to investigate the applicability of advanced imaging techniques to the problem of preserving the NLM's biomedical collection. In addition, research into imaging techniques that support medical educational packages employing

digitized radiographic, dermatological, and other imagery is also being pursued.

Electronic Document Storage and Retrieval Program. The NLM is responsible for preserving the print-based record of biomedical knowledge. A substantial fraction of its collection, like the collections of all libraries, is deteriorating. In large part this deterioration is a result of embrittlement caused by the use of acid-containing paper since the middle of the last century as a print medium, which poses the risk of spontaneous destruction of printed works in as little as thirty years. While the NLM is implementing preservation by microfilming, a standard means for archiving such endangered materials, the LHNCBC is investigating advanced electronic imaging technologies as an alternative means of preservation which promises improved access and communications as well as image enhancement possibilities. Additionally, the principles governing the acquisition, storage, and retrieval of document page images are potentially applicable to a wide range of biomedical images as well.

As reported in last year's *Programs and Services*, a major outcome of early experiments was the realization that a distributed system comprising intelligent stand-alone workstations for the critical functions of document capture, quality control, and archiving (image transfer from magnetic disk buffer to optical disk) would better serve the process of accomplishing document preservation via electronic imaging. An effort was therefore undertaken to design a distributed system of workstations for the implementation of these essential functions. The intelligent workstation for citation search via Grateful Med and the retrieval and display of document images, was completed in early FY 1988. In November 1987 it was demonstrated outside the laboratory to participants in the History of Medical Informatics Conference. The images displayed in conjunction with a Grateful Med search included those from journal articles and books stored on optical disk as part of the preservation experiment. Other workstations to serve the functions of quality control and archiving have recently been completed.

In order to link these intelligent workstations into a distributed network for document conversion, there are choices to be made for optimum operation: loosely coupled vs. tightly coupled. The former implies the intermediate storage of images on removable magnetic media (e.g., Bernoulli disks) and the manual transfer of these disks among the workstations performing the various functions. The tightly coupled option is to link the workstations via a high speed network allowing image transfer without manual intervention. Issues that arise in considering these alternatives include the bandwidth and protocol issues to be dealt with in the tightly coupled case and the organizational and management issues in the loosely coupled case.

As part of the continuing experiment, a cost model was developed on the basis of certain assumptions. The conversion process is dominated by the two most time-consuming stages, document scanning and quality check. The model is undergoing further refinement (e.g., to include the remaining stages and introduce cost dependencies in system parameters) to allow its use as a tool for tradeoff analyses.

This research into the applicability of electronic imaging to the problem of preserving the biomedical literature is continuing. An interim report on this work was presented to the Board of Scientific Counselors in FY 1987 and several briefings were conducted for senior management during FY 1988. The research findings and design techniques have been the subject of various papers presented and published this year.

Digital Biomedical Image Processing. The activities in this R&D area are directed toward developing and evaluating improved techniques to capture, store, and display medical images for computer-based

educational systems. Biomedical images of interest include both multiple gray level images (e.g., radiographs) and high resolution color (e.g., dermatologic slides). Other images of interest include monochrome and color material from the History of Medicine collection.

The capabilities of the Image Processing Laboratory were described in last year's *Programs and Services*. An activity this laboratory is currently supporting is a collaborative experiment with the National Center for Health Statistics and UCLA's Division of Medical Imaging. As a participant in this experiment, the laboratory supports format conversion and other processing for high resolution digitized radiographs received from UCLA on tape, and displays the images for evaluation and manipulation by radiologists sponsored by the National Center for Health Statistics.

Capabilities incorporated in the laboratory this year include high resolution digital capture and display of 35mm slides at 200 dpi, and paper documents and color photographs at various selectable scan densities up to 300 dpi. Software has been developed to: format the scanned images for display; allow a user to select portions of an image for viewing; and zoom, scroll, and otherwise manipulate an image. Work is proceeding on developing a portable system to retrieve and display high resolution color images outside the laboratory environment. The vehicles selected for this development are the IBM PS/2 Model 80 and IBM AT-class machines. While the resolution limits imposed by the state of the art hardware in these devices may be overcome by image manipulation software, there is a drastic reduction in the number of displayable colors. In order to maximize color fidelity, packages are being developed to select an optimum set of 256 displayable colors from the 16 million possible colors resident in the original image file.

Other research was conducted to investigate digital capture and encoding of radiographs to improve the image signal-to-noise ratio, and windowing techniques to provide high resolution images in video format on standard television video (also called NTSC) systems. Compared to analog approaches, these techniques were found to provide improved image quality on low cost personal computer workstations. Image processing techniques were also explored to isolate and display localized regions of interest on digitized radiographic images. As part of this research, a prototype x-ray imaging system (XRIS) was developed using an IBM AT controlling a "frame grabber" subsystem and a CD-ROM storage unit capable of online access to half a gigabyte of image data and displaying a 512x512 pixel image.

Computer and Image Technologies for Health Professions Education

The Lister Hill Center's Educational Technology Branch focuses on the use of innovative information technologies for learning in the health sciences. The Branch undertakes its own prototype development, and maintains The Learning Center for Interactive Technology where examples of courseware are demonstrated for NLM visitors.

Computer-based Curriculum Delivery Systems (CCDS). CCDS introduced the first interactive videodisc (Basic Medical Pathology) to U.S. medical schools in mid-1983. At that time there were 12 schools with a total of 12 student stations in the fledgling field-testing network. By mid-1988 there were 88 institutions involved and the number of interactive video student work stations had increased to more than 170. New schools continue to apply for field-test status, particularly for the pathology project.

The Teenage Suicide program won the Silver Cindy Award from the Association of Visual Communicators. The orthopaedic anatomy programs (knee and forearm) were made a permanent part of

the continuing education program of the American Academy of Orthopaedic Surgeons (AAOS) by being made a part of the IOI (Independent Orthopaedic Instruction) section of the annual meeting. CCDS project personnel facilitated the introduction of Grateful Med (an instructional course and a scientific exhibit) at the 1988 annual meeting of AAOS. The CCDS interactive video programs and Grateful Med will again be a part of the annual meeting in 1989.

Four new pathology videodisc programs ("Necrosis", "Thrombosis, Embolism, and Infarction", "Edema, Congestion, and Shock", and "Chronic Inflammation and Wound Healing") were released to the test sites during FY 1988. Post-production editing of three of the remaining units ("Acute Inflammation: Exudates and Phagocytosis", "Acute Inflammation: Chemical Mediators", and "Neoplasia: Metastasis and Cell Differentiation") is either complete or nearly so. The last two units ("Cellular Accumulations" and "Neoplasia: Benign vs. Malignant States") are scheduled for production during the first quarter of FY89.

Along with the new videodiscs, Version 3.0 of the pathology courseware was distributed to the network during the summer of 1988. Field-testing of three orthopaedic programs (Knee Anatomy, Forearm Anatomy, and the clinical case simulation "A Chronic Unstable Knee") was initiated in collaboration with AAOS during the summer of 1988.

A paper entitled "Teaching Pathology in the 21st Century: An Experimental Automated Curriculum Delivery System for Basic Pathology" was accepted for publication in the Archives of Pathology and Laboratory Medicine.

Dermatology Visual Database Project. Technical progress in image capture and display has continued with the development of a high-resolution color slide scanning station. An evaluation of SONY SHR analog (1050 line) video suggests that this spatial resolution will satisfy the needs of dermatologists for image quality. A comparison study of 1K digital vs. photographic slide images for diagnostic performance is in preparation.

NTSC recording using the APDB RIG vertical camera system resulted in a videodisc judged of high quality by dermatologists; this collection of pigmented lesion clinical and histologic images will be utilized in an interactive program by Dr. Charles Sneiderman using the IBM Infowindows hardware and IWPS software for a demonstration to the American Academy of Dermatology (AAD). Collaboration with the AAD continues with a study of photographic standards for optimal video capture and a prospective collection of skin tumor photographs for analog and digital video recording.

Library Growth. In recent months, the Library Growth project staff has devoted much of its time and energy to completing a statistical file that will be the basis for a sequel to the 1987 Research Library Trends report. The file will be complete and ready for analysis early in FY 1989 and will include at least 12 years' annual statistics from 35 libraries that are in most cases recent new members of the Association of Research Libraries. The libraries' collections range from Colorado State's 1.1 million volumes to Toronto's 5.6 million, and annual expenditures are from about $5 million to $20 million. The study will provide opportunities to compare recent trends and relationships in these relatively young libraries with those of the typically older, larger, and more established libraries that are represented in the 1987 report.

The project staff has continued to work with Dr. John Reid, University of Missouri, to plan and conduct factor analytic studies that seek to identify traits or dimensions underlying library "personalities." Data analysis is scheduled to begin early in the fall of 1988.

Time Project. The focus of the Lister Hill Center's TIME Project (Technological Innovations in Medical Education) has been to address the perceived need

by many medical educators for more patient-centered teaching during the early phases of medical student training. The project has created the "interactive case study," a voice-activated, videodisc patient simulation model which provides a patient context for faculty teaching in the medical school classroom.

Project activities during FY 1988 included further classroom presentations and an expanded evaluation of the TIME model, the completion of a third interactive case study in geriatrics, and continued presentation and demonstration of the interactive case study model to medical faculties and professional organizations.

In FY 1987 a formal evaluation of the TIME model was conducted by field testing the interactive case study materials in the classroom at Albany Medical College, Georgetown University School of Medicine, and the University of Cincinnati Medical School as described in the 1987 *Programs and Services*. Analysis of the findings showed significant learning gain by students, highly effective performances by faculty, and high levels of acceptance of the model by both. The data also clearly indicated that the model offers an effective means of changing student attitudes, clarifying their values and revising patient stereotypes.

The evaluation effort continued through FY 1988. The interactive case studies were presented to second-year students at the George Washington University School of Medicine and the University of Missouri School of Medicine, again as part of the introduction to clinical medicine segment of the curriculum. Also, later in the year, faculty who participated in the 1987 field test at the University of Cincinnati and Georgetown University presented the interactive case studies to a new group of second-year students.

Evaluation data gathered at these presentations with the same instruments used in the 1987 field test confirmed the findings from prior field tests of the model. In all, more than 800 second-year medical students have seen the interactive case studies and reported their reactions.

A follow-up evaluation was conducted at the 1987 field test sites to determine whether the aforementioned attitudinal shifts had lasted and what impact, if any, the case presentations had on student attitudes and behavior with actual patients during the first year of clinical training. Questionnaires were administered in summer 1988 so that a year had passed since the presentations. The results of the follow-up study are currently being analyzed and will be published.

The feasibility of developing and distributing interactive case study materials on a broad basis was a question of interest to the project. A letter of inquiry was mailed to each medical school curriculum director in the United States and Canada to assess the degree of interest in using the TIME model for classroom teaching. Thirty-nine institutions responded positively and, in turn, received a videotaped demonstration of the model for faculty viewing.

"The Case of Lucille Brandon" was completed in 1988. This simulation is a geriatrics case concerning a 78-year-old woman with dementia of unknown etiology. The problem involves identifying the different types of dementia in the elderly and raises many of the issues of aging which the families of the ailing elderly face.

A prototype faculty guide to using the interactive case study model for classroom teaching was developed. After the prototype is field tested, guides will be written for each case study. Ultimately they will be used in faculty workshop sessions to orient professors to the effective use of the model in the classroom and provide strategies for introducing the psychosocial and ethical aspects of the patients' problems.

Numerous presentations of the interactive case study model were made to professional and academic groups in FY 1988. Formal presentations were made at the Karolinska Institute in Stockholm,

Sweden, and at the annual conference of the Royal College of Physicians and Surgeons and the American Board of Medical Specialties in Toronto, Canada. In addition, the model was presented at the annual meetings of the American Medical Association and the Association of American Medical Colleges, and to representatives of the American Board of Pediatrics. The project was also featured in a three-hour national teleconference entitled "Healthcare Interactive Videodisc Showcase," as well as in a major article in the *Washington Post* on the use of videodisc technology in classroom teaching.

The goal of the TIME Project is now to integrate the interactive case study model into an existing medical school curriculum. More simulations must be produced to represent the variety of patients and diseases students will face when they become practicing physicians. More faculty must be involved in using the simulations in the classroom and in expanding the experiential teaching strategies around the model. More medical schools must be involved to make these materials and this educational methodology affordable.

A major effort during FY 1988 has been the successful negotiation of a cooperative agreement between the National Library of Medicine and Georgetown University School of Medicine to transfer the TIME Project intact to the medical school. By FY 1989 the interactive case study model will be integrated into the existing medical school curriculum at Georgetown University and made available to other interested medical schools throughout the country.

The Learning Center For Interactive Technology. The Learning Center For Interactive Technology (TLC) began operations in March 1985. The TLC consists of two major activities: 1) a central location where various microcomputer and interactive video information and educational technologies are demonstrated, reviewed, and evaluated and 2) a personal microcomputer training facility for NLM staff.

In FY 1988 The Learning Center staff provided 1,600 demonstrations and "hands on" experience for 722 visitors from the United States and foreign countries. This brings the total number of visitors to 1,763 since the TLC opened.

New programs acquired during the year include:

- PathMAC--a hypertext pathology curriculum using a WORM optical disc developed by Cornell University Medical College.
- The Computer-Based Examinations (CBX) developed by the National Board of Medical Examiners.
- A Macintosh/hypercard-based interactive videodisc program to teach echocardiograph interpretation, developed collaboratively by NLM and Yale University.
- Advanced Combat Trauma Life Support interactive videodisc program developed by the Naval Health Science Education and Training Command.
- ONCOCIN--a computer-based chemotherapy management consultant designed to assist oncologists with patient care, developed by Stanford University.
- Introduction to Cardiovascular Examination interactive videodisc program, developed by Mirror Systems, Inc.
- Several CD-ROM applications, especially those providing MEDLINE under license, including the Silver Platter Information System, Dialog On Disc, and Compact Cambridge Abstracts.

Two temporary displays were developed for the exhibit area in the hallway adjacent to the TLC. A "History of Information Technology" timeline serves as a unifying theme for all displays. The first display, entitled "Technological Advances in Computing Ability," traced computing innovations from the abacus to microchips. The second display profiled several computer pioneers from the seventeenth and nineteenth centuries.

In FY 1988 the microcomputer training facility

conducted 24 microcomputer classes for 261 NLM staff members. Since the training facility became operational in July 1986, 57 classes have been conducted 562 trainees. A total of 14 NLM-sponsored and 7 non-sponsored events were also held. The training room has been equipped with hearing assistive devices and training aids to accommodate the needs of the hearing impaired and physically handicapped NLM employees.

Nursing in the Public Health Service. "Nursing in the Public Health Service" is a videotaped documentary of the accomplishments of nursing within the PHS from 1914 to present. Commissioned Corps and Civil Service nurses are highlighted providing direct nursing care to the many constituencies served by the PHS. Final production of this multi-year effort was completed in 1988. The program will be available via NLM interlibrary audiovisual loan and from National Technical Information Service.

Audiovisual Program Support. The Audiovisual Program Development Branch (APDB) applies current and emerging video communications technologies and audiovisual techniques to Lister Hill Center research, development, and demonstration projects and to the information needs of the health sciences community.

The APDB operates and maintains a videodisc premastering facility. A sophisticated electronic videographics system, improved one-inch videotape recording equipment, and the upgrading and reconfiguration of the Center's CMX computerized editing facilities have allowed the facility to produce state-of-the-art visual materials. A flexible, computer-controlled still video transfer system enables the Branch to integrate slides, transparencies and hard-copy visuals--either static or in motion--into videotaped materials with higher quality and greater effectiveness.

The Branch continues to provide premastering expertise in the creating, recording, and editing of visual materials and narration audio for the Basic Medical Pathology Project. During FY 1988, four units were brought to the Level III laser videodisc final stage, and four additional units are in the latter stages of premastering development. This series of experimental teaching programs makes use of videomicroscopes, a video still image transfer system, a BOSCH electronic videographics system, and a computerized CMX electronic editing system to produce high quality videotapes suitable for conversion to computer-controlled videodiscs.

Still and motion cardiac ultrasound images, supplied by Dr. Carl Jaffe, Yale University School of Medicine, were masked and transfer/edited to one-inch premaster videotape from which a DRAW (Direct Read After Write) videodisc was produced. Following review of this disc, additional visual materials were added to the premaster videotape, which was then used to produce a Level III laser videodisc.

APDB continues to provide consultation, technical advice, and project management support to a project to photograph, in 35mm format, approximately 75,000 historical images in the Library's collection and to produce a one-inch premaster videotape suitable for the manufacture of a laser videodisc. This project follows an earlier experimental videodisc, with sample visuals, premastered by the Branch and field tested by the History of Medicine Division. The videotape on the history of PHS nursing, described in the previous section, was produced by the Branch.

APDB provided technical advice and production supervision to a two-phase experimental "Skeletal Dysplasias" project which is testing the efficacy of utilizing videodisc and computer technologies to develop, modify, and add clarifying visual materials to recorded images in collaboration with content experts at distant locations.

Production consultation, advice, and liaison with content experts are being provided to an

LHC/university collaborative project to produce a laser videodisc containing images and motion sequences pertinent to the teaching of clinical rheumatology. The development process for the premaster videotape includes transferring 35mm slide images to 35mm internegative motion picture film for subsequent transfer to one-inch premaster videotape: once at "academy aperture" for use with the best of current video technology, and once at "full aperture" for use with high-definition video when it becomes commercially available.

The Branch remained active in developing, recording, editing and premastering NLM education program materials. Among them:

- Nine presentations in the continuing "Biotechnology Seminar Series."
- "Communicating for Health--1988," a 15-minute videotape program on the history and present programs of the NLM, was produced, with subsequent special versions made in Japanese, Chinese, and Spanish, and an "open captioned" version for the hearing impaired.
- An informational videotape program was produced to explain the information-sharing activities of the member agencies of the CENDI (Commerce, Energy, NASA, Defense and the NLM) organization.
- A new NLM interactive sampler videodisc was produced containing, among other sources, the 1988 version of "Communicating for Health" for use in the Visitor's Center.
- Four short "Eye on Medicine" video vignettes on major NLM programs were produced on videotape, as part of a six-unit package of programs to be broadcast on the Discovery Cable TV Channel.
- APDB assisted Armand Hammer Productions and the United States Information Agency in the preproduction and production of the U.S. portion of a simultaneous two-way National Cancer Institute satellite teleconference with the Soviet Union, featuring reports and idea sharing between cancer experts in the two countries.
- The proceedings of three NLM-sponsored symposia were videotaped, edited and made available for NLM distribution: "Images of the Health Professions in the Popular Arts," in October 1987; "History of Medical Informatics," in November 1987; and "Symposium on Physical Fitness and Sports Medicine," in June 1988.

APDB's Graphic and Still Photography Labs continue to provide visual information materials for the Library. The Graphics Lab contributes to the upgrading of the Branch's premastering facility and to the more efficient and effective generation of personally designed slides and other graphics materials through the creative use of electronic videographics, and the exploitation of emerging microcomputer graphics programs. The Still Photo Lab makes similar contributions by providing video camera operation and making creative use of the still video transfer system.

The Branch also provides projection, audio recording and other audiovisual support to conferences and meetings scheduled in the Lister Hill Center Auditorium and the NLM Board of Regents Room.

Extramural Grants and Contracts

Arthur J. Broering
Acting Associate Director

The Library's Extramural Programs Division provides a variety of assistance opportunities through grants and contracts to the health science community. This support, authorized by the Medical Library Assistance Act of 1965 and extensions, and by Section 301 of the Public Health Service Act as amended, has assisted authors and scholars, researchers and academicians, librarians, media and communication experts, computer scientists, and information network designers and managers in improving access to health knowledge.

Supported projects range from research on fundamental questions about information in medical decision-making, to the planning and operation of large-scale institution-wide integrated information networks, to historical writings on significant health topics, to the development of basic information access services at local and smaller health facilities. Regional Medical Library contracts, as authorized by the Medical Library Assistance Act, are described in the section on Library Operations.

In June of 1988 NLM hosted a meeting of consultants to consider whether modifications in the Medical Library Resource Grant Program were advisable. Attending were librarians from hospitals, academic medical centers, and research institutions, a library school dean, a medical internist, and a professor of medical informatics. It was the consensus of the group that a number of changes would enhance the potential impact of these awards. Following consideration by the Board of Regents early in FY 1989, announcements about the details of an amended program and application procedure will be made to the potential applicant community.

Pursuant to NLM's Long Range Plan, high priority areas for extramural awards in FY 1988 continued to be in the general areas of investigations and research career stimulation in medical informatics, introduction of an NLM initiative in the computer and information science aspects of biotechnology, and, in the area of Integrated Academic Information Management Systems (IAIMS), continued efforts to promote the principles and potentials of this relatively new concept as well as to facilitate the final phase at IAIMS model institutions.

Regarding the management of biotechnology data, 1988 marked a promising beginning when the Library received funds to start a new National Center for Biotechnology Information. Of the total received, $1 million was used by the Extramural Programs to fund 7 research grants in this new and emerging field. The successful applications were among some 36 proposals submitted in response to an NLM issued Request for Application (RFA). By the end of the year, plans were under way to circularize a similar RFA in FY 1989 for the same amount.

Several of the Integrated Academic Information Management System (IAIMS) grantees, having successfully created an IAIMS plan for their institution and nearly completed model development and testing, became eligible for IAIMS Phase III Implementation support. Grant applications were received from Columbia University, Georgetown University, the University of Maryland at Baltimore, and the University of Utah. It is anticipated that another competition of the implementation phase will be announced for 1990 and that the two review cycles will result in the formal establishment of the 5 or 6 models to fulfill the commitment made by NLM to the Congress when the program was begun in 1983. NLM has announced it will direct its available IAIMS funds toward Phase III implementation efforts in FY 1989, and to existing IAIMS grantee commitments. Although new Phase I or II awards will not be made until further notice, NLM's Library Resource Grant Program supports IAIMS-related activities, and these kinds of project may still compete for support.

Extramural Program expenditures for FY 1988 totaled $14,724,000 for 90 new and continuing awards (see Table 10). Descriptions of the grant programs, including examples of funded projects, are contained in the following sections.

Training Program

Research issues in the health information and health computer sciences call for highly trained creative talent, able to articulate medicine with computers and health care with information science. There is a particular need in academic medicine for this new discipline--medical informatics. Through its training program, NLM provides grants for research career training in this field.

In 1988, 8 awards were made. Each site offers an excellent setting for didactic instruction, involvement in computer science studies, and opportunities for work in advanced information science research. After training, these investigators will contribute to the growth of science by their studies of the role of knowledge in professional life, by analyses of the social structures for managing knowledge, and by advancing the frontiers of the computer sciences for organizing, retrieving, and utilizing health knowledge. Fifty-five pre- and postdoctoral trainees were in the program this year.

The eight training sites and Directors are:

Lael Gatewood, Ph.D.
Professor and Director
Laboratory Medicine and Pathology
Division of Health Computer Sciences
University of Minnesota (Minneapolis)

Robert A. Greenes, M.D., Ph.D.
Director, Decision Systems Laboratory
Department of Radiology
Brigham and Women's Hospital
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Research Grants

The Library continued its support in the areas of medical informatics and health library-information science. As an extension of its long-term interest in medical informatics, the Library, as noted previously, also initiated new work in computer science and knowledge issues related to biotechnology.

In health library-information science, research issues concern the organization of bibliographic databases and retrieval of the literature from them, the development and evaluation of new organization or retrieval methods, particularly those that foster the fullest possible utilization by the end-user.

Another area concerns the analysis of bibliography itself as a reflection of scientific activity. This year saw continued progress by Professor Marie Abate at West Virginia University, and Professor Maryellen Sievert at the University of Missouri-Columbia in comparative studies of literature searching schemes. At the University of Michigan, work on bibliographic measurement and on studies of such measures for assessing scientific impact were highly recognized in the research of the investigator, Miranda Pao. Pao's work also represents a potential contribution of another evaluative tool for framers of health research policy.

In the area of medical informatics NLM was able to sponsor only a small number of additional new projects this year. The field, however, continues to attract the interest of other institutes at NIH, and several investigators who had earlier received NLM training support were funded by the National Cancer Institute and the National Heart, Lung, and Blood Institute.

At the University of Pittsburgh, Dr. John K. Vries has begun work on an expert system which will archive medical information. The proposed system will automatically index medical text with key words and will retrieve information by means of requests formulated in natural English. The knowledge base for the projected system is a semantic network generated from the thesauri of medical terms. Although the project will eventually cover all of medicine, the initial domain under development is clinical neuroscience.

At Children's Hospital in Boston, Dr. Brian Bergeron has received an initial award for exploring, validating and promoting graphics-based computer simulations in medical education. The computer graphics technology offers a potential of extremely realistic simulations which stimulate the learner through a highly rapid and varied interactive modality. The several simulations undertaken will each be internally complete, but the overall project strategy will lead to facilitated communications among these databases.

In the newly established grant initiative of biotechnology information, a brief summary of all new awards seems appropriate. Recent improvements in computer algorithms for comparing DNA and protein sequences have dramatically decreased the amount of time required to compare an unidentified sequence to a DNA or protein sequence library. Dr. William Pearson, University of Virginia, has developed a computer software program, FASTA, to make such comparisons. With the research grant from NLM, he and his colleagues will test several strategies to improve both the speed and sensitivities of protein sequence comparisons by incorporating more structural information into the process.

Dr. Eugene Myers, University of Arizona, will also be working on computer algorithms for a number of computational problems arising in molecular genetics. Specifically, he will focus on multiple sequence alignment, finding local homologies, designing oligonucleotide probes, and RNA secondary structure prediction.

Dr. Richard Roberts, Cold Spring Harbor Laboratory, proposes to develop software and databases that will be useful for the analysis of newly derived sequences. Whenever anomalies are found in a new sequence that distinguish it from similar or related known sequences, an error may be present. Routines to detect these anomalies will make extensive use of the properties of the coding regions. A second endeavor is the production of a database of sequence and structure motifs that are found in proteins, and that can be correlated with function.

Dr. John Markley and colleagues, University of Wisconsin, propose to establish an archival repository for nuclear magnetic resonance spectroscopic data on proteins. Database management software will be developed to collect, assemble, maintain, analyze, and disseminate information in the database.

Each of the stages of data acquisition, management, reduction, and distribution needs to be automated and to have a high degree of flexibility. Dr. Thomas Marr, Los Alamos National Laboratory, proposes to develop schema for computer representation and reduction of raw data associated with the major methods of chromosome mapping. The work will include the development and implementation of a prototype relational database schema on a Sun workstation.

Using established methods of knowledge representation and rule-based expert systems, Dr. Douglas Brutlag, Stanford University, proposes to develop a symbolic simulation of DNA metabolism. Both classic production rules and an assumption-based truth maintenance system will be used. Such simulation tools will allow one to emulate many complex reactions involving several enzymes simultaneously.

The project directed by Dr. John Merriam, University of California, Los Angeles, involves the preparation and publication of a catalog of the cloned DNA of Drosophila. This catalog makes it possible for a worker interested in a particular chromosome site or gene to see if it has already been cloned or if a nearby site has been cloned or transformed.

Medical Library Resource Grants

Medical Library Resource Grants exist in two forms: the Improvement Grant for collection development and available to single institutions and consortia, and the Project Grant for initiating or expanding library and information services. In FY 1988, Resource Improvement Grants were awarded to two consortia and to six single institutions.

Three Resource Project Grants were awarded in FY 1988. The library of the Massachusetts General Hospital received funds to install an automated integrated library system with the long-range plan of extending it to outlying sites including affiliated hospitals. The American Medical Association library was awarded grant funds to organize and preserve a Historical Fraud Collection consisting of correspondence, promotional literature, advertisements, testimonials and investigative statements regarding health fraud acquired by AMA's Bureau of Investigation. At UCLA, Professor Ynez V. O'Neill in the School of Medicine's Department of Medicine received a Resource Project Grant to compile an "Index of Medieval Medical Images in North America." It is proposed to describe and index images with medical components in all medieval manuscripts currently held in North American collections (an estimated 55-60 manuscripts containing some 5,000-6,000 images).

IAIMS Program

Integrated Academic Information Management Systems (IAIMS) are institution-wide computer networks that link and relate library systems with individual and institutional databases and information files, within and external to the institution, for patient care, research, education, and administration. Resource grants have been made to assist medical centers and health science institutions in planning and development projects that will lead to the implementation of IAIMS. The overall goal is to create organizational mechanisms within health institutions to manage more effectively the knowledge of medicine, and to provide for a system of comprehensive information access.

Using the Resource Project Grant mechanism, NLM has provided support for: 1) institution-wide IAIMS planning and policy analysis, 2) model development and testing, and 3) implementation of detailed, tested plans for a full-scale IAIMS.

Some of the functions undertaken by grantees during planning include the preparation of a 10-year strategic plan for the institution, development of an institutional information policy, assessing the technological capabilities of the institution, and

defining the information management needs and requirements. From these activities an IAIMS plan is created which serves as the guide for the second phase of activity, model development.

In Phase II, IAIMS concepts are being tested on a small scale in research, education, and/or patient-care areas. Health science institutions that have completed an IAIMS plan and can demonstrate examples of successful modeling of critical elements of their plan throughout Phase II support, may request, in the next competition in 1990, NLM assistance to proceed with full-scale IAIMS implementation in a Phase III award.

During FY 1988, 13 IAIMS planning and model development projects were active, including those having received grant awards in previous years. IAIMS Phase I planning was under way or nearing completion at the American College of Obstetricians and Gynecologists, Dartmouth College, Harvard University, Rhode Island Hospital, the University of Michigan, and the University of Pittsburgh. IAIMS Phase II model development and testing began at Baylor College of Medicine; was under way at Duke University and the University of Cincinnati; and was near completion at Columbia University, Georgetown University, the University of Maryland, and the University of Utah.

The Baylor College of Medicine is the newest institution to receive NLM support for the Phase II activity, having successfully completed an IAIMS planning grant. Their developmental efforts will concentrate on creating and testing an advanced information system for researchers and clinicians called "The Virtual Notebook." The "Notebook" will feature a scheme for representing complex information structures, a communication manager for facilitating task assignment and coordination, and a facility for automatically importing relevant information from external sources such as libraries. The Virtual Notebook will be tested in four settings at the university.

Three institutions became the newest members of the select group receiving NLM support for information management large-scale systems. IAIMS Planning grants were awarded to Dartmouth College, and the Universities of Michigan and Pittsburgh.

Publication Grants

The Publication Grant Program, authorized under the Medical Library Assistance Act, provides short-term support for not-for-profit biomedical, scientific publications. A companion international publication program, authorized under Public Law 83-480, utilizes special foreign currencies in the support of biomedical publications. The Special Foreign Currency Program, administered along with the Publication Grant Program, is described in the chapter on International Programs.

Among the types of publication supported are critical reviews and monographs in the biomedical sciences, secondary literature tools, such as bibliographic guides, atlases, etc., publications on biomedical communications and information services, and studies in the history of medicine which lead to the publication of significant monographs in this field.

During FY 1988 NLM awarded 11 Publication Grants totaling $283,593. Of these, 5 were new awards, including a review of the development of renal medicine and dialytic care in the United States and a history of the Kaiser Permanente Medical Care Program, a prototype and still one of the major health maintenance organizations (HMOs) in the United States.

Among the studies published in FY 1988 resulting from prior support in the Publication Grant Program was a biography by Saul Benison, A. Clifford Barger, and Elin L. Wolfe of Walter B. Cannon, *The Life and Times of a Young Scientist* (Cambridge, Massachusetts and London, England, The Belknap Press of Harvard University Press, 1987). One of America's pioneer research investigators in the biological sciences, Cannon was not only an eminent

physiologist, but a major figure in the development of the Harvard Medical School in the twentieth century.

Also received in FY 1988 was a significant monograph on a complex subject, Nathan Sivin's *Traditional Medicine in Contemporary China* (Ann Arbor, Michigan, Center for Chinese Studies, The University of Michigan, 1987). The author is one of the very few historians of science and medicine thoroughly grounded in the language and culture of Chinese scientific literature.

A valuable reference work for those interested in ticks and tick-borne disease was also published in FY 1988 with support from the Publication Grant Program: John G. Matthysse and Murray H. Colbo's *The Ixodid Ticks of Uganda* (College Park, Maryland, The Entomological Society of America, 1987). This book is a taxonomic survey of the ixodid tick species of Uganda, as well as a manual for their identification and of geographically associated African ticks. The book is expected to be of use to a variety of medical and veterinary entomologists, epidemiologists, and other scientists. (A complete listing of publications received in FY 1988 resulting from NLM Extramural Programs support appears in Appendix 2.)

Table 10
Extramural Grant and Contract Program
(Dollars in thousands)

Category	FY1986		FY1987		FY1988	
	No.	$	No.	$	No.	$
Research	37	5,609	40	6,391	40	5,857
Resource projects	19	2,604	15	2,758	15	3,474
Resource improvement	15	190	10	195	8	114
Training	5	1,095	8	2,147	8	2,619
RML's	7	2,325	7	2,318	7	2,330
Publications	17	426	17	475	12	330
(IAIMS projects*)	(9)	(2,205)	(9)	(2,549)	(9)	(2,822)
(Med. Info. Resrch)	(28)	(4,029)	(28)	(4,256)	(25)	(3,865)
(Biotech. Research)	- - -	- - -	- - -	- -	(7)	(1,000)
Total:	100	$12,249	97	$14,284	90	$14,724

*Includes both IAIMS resource and research projects

Office of Computer and Communications Systems

John Anderson
Director, Information Systems

The Office of Computer and Communications Systems (OCCS) provides information processing capability to meet NLM needs and, in so doing, determines and meets the data processing and data communication requirements for: (1) disseminating biomedical information to thousands of institutional and individual health professionals around the nation and world; (2) operating the world's largest library in a single technical area--biomedicine; and (3) providing MIS (Management Information System) services to NLM, including office automation.

OCCS: (1) implements computer and communication systems using cutting-edge technology and state-of-the-art techniques; (2) analyzes, plans, and provides real-time, online, around-the-clock information services for increasingly sophisticated users; (3) schedules and controls maintenance and publication of dozens of databases, each measured in the billions of bytes (characters); (4) operates a modern computer center of fully redundant, fail-safe hardware and software; (5) conducts performance measurement and capacity planning for computer hardware, operating systems, database management systems, transaction processors, etc.; and (6) produces and distributes data and software for distribution to approximately two dozen International MEDLARS Centers.

The organization of OCCS is a direct reflection of these responsibilities. Computer and communication systems are:

- developed and implemented by the Development Branch;
- enhanced and maintained by the Application Services Branch;
- executed on computers under operating system control by the Systems Support Branch; and
- provided as an around-the-clock service by the Computer Services Branch.

Development Branch

The Development Branch is responsible for analyzing, designing, and implementing computer-based systems to support NLM's library processing requirements for new applications. Activities during 1988 have concentrated on systems development emphasizing the use of IBM personal computer workstations to support general bibliographic processing activities. The model being developed places most of the user interface processing in the workstation using the C programming language. Communication between the workstation and our IBM host computers will be supplied by the LU 6.2 protocol, an IBM protocol developed to provide program to program communication facilities. In the IBM host the workstation transactions will be processed by the Model 204 data base management system. Early work on this general model by OCCS staff has led to its being adapted by the new MEDLARS III contractor, Phoenix, for the underlying software to support implementation of the Selection and Acquisition application. Assuming a successful implementation of these applications, the model will be extended to support other technical service and bibliographic applications, where appropriate.

Enhancements to the Grateful Med package have continued during the year. More than 12,000 copies of the software have been sold so far. Version 4.0 of Grateful Med has been developed and will be released in December 1988. There are many enhancements in Version 4.0, but the major accomplishment was rewriting the entire system in "C" programming language, thereby creating a version that will be adapted to run on Macintosh PC's. Grateful Med has also gone international this year. Sweden has a prototype Version 3.0 for their Medical Information Center (MIC), and anticipates distributing Version 4.0 after the first of the year. Australia has successfully demonstrated Grateful Med on their host system and Canadian users can now select their own setup procedures from a Grateful Med menu.

Other development activities include the continued expansion and enhancement of the DOCLINE interlibrary loan system, and a completely new thesaurus handling system to support all aspects of the management of the Medical Subject Headings application.

Applications Services Branch

The Applications Services Branch is responsible for analysis, design, creation, maintenance, enhancement, and problem resolution for over 2,000 application programs and data streams and 149 databases. These support services are provided using such sophisticated programming software as PL/I, ALC, RPG, INQUIRE, and Model 204, on state-of-art computer hardware and systems, with variable length records and interactive database/programming methodologies.

During FY 1988 the Applications Services Branch has been involved in a variety of undertakings to enhance, modify and develop various support services throughout the Library:

- Procedures, modifications, and enhancements for semi-monthly updating of MEDLINE.
- The AIDSLINE database was created and made available.
- Significant work was done this year to streamline the NLM billing system.
- Changes were made to the INPROC database and it was successfully recreated with interfaces to the new Model 204 input processing system.
- Software development to support MARC specifications for CATLINE and AVLINE data was provided. Also, procedures were developed and the first set of unique identifiers for genetic sequence databases were put in the MEDLINE class of databases.
- Staff have worked with other NLM staff and with contractors to develop the new Model 204 DBMS-based MeSH system. This system is near completion and will replace the current MEDVOC system that has served the NLM well for many years.
- A new system was generated for a Bioethics online edit module.
- The TOXLINE database was regenerated to be two royalty and two nonroyalty databases. This file was programmed to capture concept codes and biosystematic codes and add them as keywords and then convert to MeSH.
- Analysis and conversion of the ISAM Index Files for 149 databases in INQUIRE to VSAM was accomplished during the year.
- A new Elhill DOCUSERS file was successfully coded and implemented.
- The multi-tape problem in PHOCOS was successfully corrected. The conversion of the CICS application programs under CICS release version of 1.70 was accomplished successfully.
- AIMS subsystem "CHECKIN" has been rewritten from ACT/1 to CICS providing Basic Mapping Services (BMS) and is in production status
- AIMS subsystem "BIB PROCESSING" has been rewritten from ACT/1 to CICS providing BMS and is in beta test.
- Staff developed documentation standards for on-line system documentation, common naming conventions, data dictionary, structured programming and development of an online documentation integrated systems.
- Re-leveling of all the MEDLINE backfiles was accomplished.
- Many of the problems associated with the MILOAN system and the INQUIRE DBMS were resolved and the system has become much more reliable. Additionally, better documentation of this system has been completed.
- Year-end processing was highly successful with many enhancements and modifications made and successfully implemented.
- Staff developed and implemented OASIS (Online Automated Status Information System). The

system uses interactive control and tracking contained within three major subsystems (Problem Reporting, Change Control, and Inventory Maintenance Subsystems). The Problem Reporting Subsystem allows users to submit ADP related problem situations directly to the Help Desk from their PC work stations. These problem records are then routed electronically within OCCS for evaluation and resolution.

Systems Support Branch

The Systems Support Branch is responsible for hardware analysis, system software and data communications. The current NLM configuration is an IBM 3084-Q with MVS/XA (multiple virtual systems/extended architecture), TCAM (telecommunications access method) and VTAM (Virtual Telecommunications access method), an IBM 3081-K with MVS/XA, TCAM and VTAM, an IBM 9370-40 with VM (Virtual Machine), VTAM and PROFS (Professional Office System).

During FY 1988 the Systems Support Branch provided all required support for NLM mainframe operating systems, related software, and data communications. Training was provided and user-reported problems were resolved. Major efforts this year were to maximize the performance and reliability of the IBM 3084 system and to improve availability by configuring the IBM 3081 as a back-up system.

Notable activities of the Systems Support Branch during FY 1988 include:

- Installation of a new version of MVS/XA to support new IBM 3380-K models of direct access storage devices and improve system reliability and performance.
- Installation and implementation of solid state direct access devices to improve system performance.
- Conversion from CICS 1.6 to CICS 1.7 to improve overall CICS performance and to provide required functions for MEDLARS III interim systems.
- Installation and support of more than 100 software products for programmers, users, system support staff, and computer operations specialists.
- Systems Support for Model 204 and INQUIRE Data Base Management Systems which are key to MEDLARS III development.
- Data communications services for the provision of 2400 BPS direct dial service, protocol conversion for special NLM terminals, and the installation of terminals and printers throughout the NLM.
- Installation of an IBM 9370 system and a pilot evaluation of PROFS (office communication system).

Computer Services

The Computer Services Branch provides data processing services and support for users of the Library's large mainframe systems. Currently installed and operational are two IBM systems, one of them a 3081K with the performance characteristics of processing 13.5 million instructions per second, or MIPS. The second IBM system is a newly installed 3084Q with the performance characteristics of processing 24.4 MIPS. In addition, there are 2 Data General minicomputers, a DG350 and DG230. The peripheral equipment attached to the IBM mainframes consists of:

- 225 billion characters of data on 144 3380 disk drives, 8 3351 disk drives and 2 STC 4305 solid state disk drives;
- data transfer via 6 3420 tape drives and 8 3480 tape drives and 8 3480 tape cartridge drives; and
- an IBM 3800 laser printer and an IBM 3211 impact printer.

As a result of an international cooperative agreement with the British Library NLM plans to

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implement a major change to its Information Retrieval System: ELHILL 3.3.

ELHILL 3.3 has two new features. The visible feature is the capability to search multiple databases in three modes of operation under the users', control. The invisible feature is the change to the indexing and accessing of the Unified User Specification File which hold the users' SAVESEARCHES and Profiles. This was done in order to expand the total number of users that may be known to the system and speed up the accessing of this file, especially during initial entry to the system.

International Programs

Richard K. C. Hsieh, Dr.P.H.
Director, International Programs

The Library's international programs are integral to NLM's responsibilities in biomedical information. The U.S. health community depends on NLM's information retrieval system to identify the relevant information from both domestic and international journals. The world health community shares the benefits of NLM's advanced information systems.

During the past year NLM continued its bilateral cooperative MEDLARS agreements with individual countries; its cooperation with international governmental organizations such as the World Health Organization (WHO) and the Pan American Health Organization (PAHO); and international nongovernmental organizations such as the International Council for Scientific and Technical Information (ICSTI). The Special Foreign Currency Program was active in the support of critical reviews and history of medicine projects. Other NLM international activities included training for colleagues from abroad, the NLM publication exchange program (with 346 institutions in 76 countries), as well as numerous professional visitors from abroad.

International MEDLARS Agreements

The Library has MEDLARS agreements with partners in 15 foreign countries and with the Pan American Health Organization (Table 11).

The Indian Government has nominated the National Informatics Centre as the organizational entity to serve as a MEDLARS center. A formal agreement has been reached between NLM and the National Informatics Centre to set up a tape center in New Delhi to provide MEDLARS services to health professionals in India.

Table 11
International MEDLARS Centers

Tapes	Tapes/Software	Online NLM
France	Australia*	BIREME (PAHO)*
Germany	China	Canada
Japan	Sweden	Colombia
BIREME (PAHO)		Egypt
		France*
		Italy
		Kuwait
		Mexico
		South Africa
		United Kingdom

*Combined online/tapes

The National Library of Medicine has enjoyed 20 years of collaborative activities with the Pan American Health Organization. The PAHO Regional Medical Library (BIREME) in Sao Paulo, Brazil serves users in Latin American and the Caribbean countries with a subset of MEDLINE. Since international communications have become more accessible to users in this region, PAHO has instituted online access for major medical schools in Argentina, Chile, Jamaica, and Costa Rica.

Collaboration with the World Health Organization

The National Library of Medicine and the World Health Organization continued to cooperate in the publication of the *Quarterly Bibliography of Major*

Tropical Diseases and the *Bibliography of Acute Diarrhoeal Diseases*. NLM prepares camera-ready copy from the MEDLINE system, and WHO prints and distributes these to thousands of institutions in the developing countries. Also, NLM provides MEDLINE bibliographies in camera-ready form to PAHO, and PAHO prints and distributes these in the *Bibliography of Respiratory Infections in Children*.

NLM and WHO also continued a collaborative arrangement in which photocopies of journal articles are provided to health professionals in developing countries in Africa, the Eastern Mediterranean and South East Asia. Library resources in developing countries are usually insufficient and the need for biomedical and health information can be met only by drawing on the collections of the developed world. Even though NLM and WHO continue to provide some photocopies of journal articles to developing countries, this arrangement can only partially meet the demand. Unless other resources in developed countries can be found, the need for interlibrary loans to developing countries will continue to grow.

Special Foreign Currency Program

The Library's Special Foreign Currency Program, which is authorized under Public Law 480, employs U.S.-owned local foreign currencies to support biomedical scientific publications useful to U.S. health professionals. The oldest of the Library's extramural support activities, the Public Law 480 Program is administered in the International Programs Branch of the Extramural Programs Division.

During FY 1988 41 projects totaling $689,782 (equivalent in foreign currencies) were active in this NLM program. About 75 percent of the funding during FY 1988 supported projects in India, 24 percent in Poland and 1 percent in Egypt. Among the studies published in Poland under the Public Law 480 Program was a comprehensive, state-of-the-art review on *Surgery of the Spleen*, edited by Professor Witold J. Rudowski and Professor S.J. Pawelski, Warsaw, Poland (distributed by the National Technical Information Service).

A new volume in NLM's Resources in Medical History Series was also published in FY 1988 through the Special Foreign Currency Program in India. This is a reprinting, with a new introduction by the distinguished American medical historian, Dr. Saul Jarcho, of John Huxham's *Essay on Fevers*. Also published in FY 1988 under the Special Foreign Currency Program in India was a translation of a significant study by two Russian neurophysiologists, Vainshtein, I.I., and Simonov, P.V., *Emotiogenic Structures of the Brain and Cardiac Activity*, New Delhi, India, Amerind Publishing Co. Pvt. Ltd., 1987.

International Meetings

The Library is a member of the International Council for Scientific and Technical Information (ICSTI). This organization serves as a meeting ground for information and abstracting agencies, commercial and governmental, from a number of countries. Common interests include economics of primary and secondary publications, transborder flow of information, electronic publication, standardization, and the information needs of developing countries. At the 1988 general meeting of ICSTI held in Orleans, France, NLM was represented by the Director for International Programs.

The biennial International MEDLARS Policy Advisory Group (IMPAG) meeting was held in Canberra, Australia in 1988. The National Library of Australia was host for the meeting. The agenda included reports from the NLM Director on the Unified Medical Language System, the National Center for Biotechnology Information, Grateful Med, and the Learning Center for Interactive Technology. Representatives of International MEDLARS Centers reported on recent center activities, including the adaptation of Grateful Med to their systems.

International Visitors

The Library continues to attract hundreds of foreign visitors each year, including medical librarians, health personnel, and government officials. Many of these visitors have responsibilities for medical, scientific or technical information in their own countries. Their interest in NLM is more than cursory, and they are officially received and briefed on relevant aspects of NLM operations and research. In 1988, visitors came from the following countries:

Australia, Belgium, Brazil, Chile, China (PRC), Colombia, Costa Rica, Ivory Coast, Czechoslovakia, Denmark, Egypt, France, Germany, Ghana, Honduras, Hong Kong, Hungary, India, Indonesia, Ireland, Italy, Ivory Coast, Japan, Jordan, Korea, Kuwait, Malawi, Mexico, Morocco, New Zealand, Nigeria, Pakistan, Peru, Philippines, Portugal, Singapore, South Africa, Spain, Sweden, Taiwan, Tanzania, The Netherlands, Trinidad, Turkey, United Kingdom, U.S.S.R., Venezuela, and the West Indies.

Administration

Kenneth G. Carney
Executive Officer

Programs and Services, FY 1988

Financial Resources

In FY 1988, the National Library of Medicine had a total appropriation of $67,910,000. Table 12 displays the FY 1988 budget authority plus reimbursements from other agencies, and the allocation of these resources by program activity.

Table 12
Financial Resources and Allocations FY 1988
(in thousands of dollars)

Budget authority:	
Appropriation, NLM	$67,910
Plus: Reimbursements	4,687
Total	72,597
Budget allocation:	
Extramural Programs	14,724
Intramural Programs and Services	51,585
Library Operations	(32,715)
Lister Hill National Center for Biomedical Communications	(12,527)
Toxicology Information	(6,343)
Research Management and Support	6,288
Total	$72,597

Personnel

Dr. Dennis A. Benson was appointed Chief of the Lister Hill Center's National Center for Biotechnology Information Branch. Dr. Benson joined the staff of NLM in 1982 as a Special Expert and has served most recently as a Computer Scientist.

Fredette D. West was appointed NLM Budget Officer, Office of Administration. Ms. West previously served as an Associate Staffer for Appropriations to Congressman Louis Stokes, U.S. Congress, where she was responsible for the review and analysis of budget appropriations for the Departments of Labor, Health and Human Services, and Education.

Peri L. Schuyler was appointed Head, Medical Subject Headings (MeSH) Section, Library Operations. Ms. Schuyler previously served as Deputy Chief of the Bibliographic Services Division.

Dr. Donald W. King was appointed within the Office of the Director as a consultant in health communications, assisting in the development of a comprehensive plan in the area of biotechnology. Dr. King has served as a Dean and Vice President of Pritzker School of Medicine and a Professor of Pathology at the University of Chicago since 1982.

Edwin P. Sequeira was appointed as a Special Expert in the Office of Computer and Communications Systems. Mr. Sequeira will provide project guidance for the NLM Gateway/ABIDE project. Mr. Sequeira had been a senior member of the Mitre Corporation staff from 1980 to 1987, responsible for developing system architecture for new initiatives to support national government programs. In addition, he has extensive experience in networking gained from employment at AT&T from 1976 to 1980.

Daniel T. Richards was appointed Collection Development Officer in the Technical Services Division. He will be responsible for formulating collection development policies and procedures and overseeing the continuing review and periodic revision of the Library's Collection Development Manual. Prior to joining NLM's staff, Mr. Richards served as Assistant Health Science Librarian for Resource and Reference Services at Columbia University (1981-1987) and as a Collection Development Officer at the UCLA Biomedical Library (1979-1981). Mr. Richards was an NLM Library Associate in 1970-1971.

Awards

NIH Merit Awards were presented to:

Nelson C. Johnson, Library Operations, "for exceptional contributions toward maintaining effective document delivery; for consistent, courteous service to NLM patrons; and for sustained excellent performance."

Dr. Lawrence C. Kingsland, III, Lister Hill Center, "for exemplary contributions to artificial intelligence research and the development of a new expert system shell."

Dr. John Parascandola, Library Operations, "for developing programs that increase awareness and promote use of NLM's important historical resources; and for directing the History of Medicine Division's expert support to special events at NLM and NIH."

Dr. Elliot R. Siegel, Office of the Director, "for outstanding leadership and management of the Office of Planning and Evaluation in carrying out the mission of the National Library of Medicine."

Sally K. Sinn, Library Operations, "for exceptional contributions to the development of systems that improve NLM's ability to create and distribute high quality bibliographic data for the biomedical literature."

The NLM Director's Awards were presented to: Betsy Humphreys, Deputy Associate Director, Library Operations, "for outstanding contributions to the advancement of the Library's mission" and to William J. Welsh, Deputy Librarian of Congress "in recognition of outstanding contributions to advancing the programs of the NLM during his long tenure as a member of the NLM Board of Regents."

The Board of Regents Award was presented to James S. Main, Jr., Lister Hill Center, "for innovative application of video and other electronic image production methods to a range of challenging and highly specialized imaging problems associated with medicine and biology."

The PHS Outstanding Service Medal was presented to Dr. Daniel Masys, Director, Lister Hill Center, "for his continued leadership and skill in planning and implementing a diversified research program which applies information technologies to the pressing communications needs of scientists, educators, and practicing professionals."

The PHS Special Recognition Award was presented to David Kenton, Office of the Director, "for continued excellence in improving and promulgating the National Library of Medicine's Biomedical Information Retrieval System."

Equal Employment Opportunity

The NLM continues to work toward the goal of Equal Employment for all employees through open meetings with staff and EEO training for supervisors.

The EEO Committee and Associate Directors reviewed accomplishments of the objectives under the NLM Affirmative Action Plan one year after its implementation. Their findings concluded that significant progress had been made in achieving the action steps specified under each EEO objective. The plan was subsequently revised and updated.

A two-day training seminar was held in December for approximately 90 supervisors and managers. The seminar, titled "The Fundamentals of EEO/AA for Supervisors and Managers," was tailored to NLM practices, policies, and procedures with some focus on such current issues as drug abuse, contracting out, and child care. Another highlight of the year was an exhibit (February 1 through May 15) in the main NLM lobby titled "Blacks in Medicine: The Institutional Setting." Employees were kept informed of the EEO programs through the newsletter "NLM EEO Update."

Table 13
Staff, FY 1988 Full-Time Equivalents (FTEs)

Program	Full-Time Permanent	Other
Office of the Director	18	2
Office of Inquiries and Publications Management	5	2
Office of Administration	39	4
Office of Computer and Communications Systems	59	2
Extramural Programs	18	2
Lister Hill National Center for Biomedical Communications	64	9
Specialized Information Services	31	3
Library Operations	216	37
Total	450	61
Total FTE Usage	511	

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Appendix 3: Board of Regents

Programs and Services, FY 1988

The NLM Board of Regents meets three times a year to consider Library issues and make recommendations to the Secretary of Health and Human Services on matters affecting the Library.

Appointed Members:

Edward N. Brandt, Jr., M.D., Ph.D.
President
University of Maryland, Baltimore
(Chairman)

Steven C. Beering, M.D.
President
Purdue University

H. Robert Cathcart
President
Pennsylvania Hospital

Don E. Detmer, M.D.
Vice President for Health Affairs
University of Virginia

Edward A. Feigenbaum, Ph.D.
Professor of Computer Science
Stanford University

Russell L. Fenwick
Senior Vice President (retired)
Bank of America

Nina W. Matheson
Director, Welch Medical Library
The Johns Hopkins University

Ann K. Randall, D.L.S.
Chief Librarian
City College of CUNY

Grant V. Rodkey, M.D.
Associate Clinical Professor of Surgery
Harvard University

Eugene A. Stead, Jr., M.D.
Professor Emeritus of Medicine
Duke University

Ex Officio Members

Librarian of Congress
Surgeon General
Public Health Service

Surgeon General
Department of the Air Force

Surgeon General
Department of the Navy

Surgeon General
Department of the Army

Chief Medical Director
Veterans Administration

Assistant Director for Biological, Behavioral, and Social Sciences
National Science Foundation

Director
National Agricultural Library

Dean
Uniformed Services University of the Health Sciences

Appendix 4: Board of Scientific Counselors

The Board of Scientific Counselors meets periodically to review and make recommendations on the Library's intramural research and development programs.

Members:

Gwilym S. Lodwick, M.D.
Department of Radiology
Massachusetts General Hospital
(Chairman)

Arthur S. Elstein, Ph.D.
Professor of Health
Professions Education
University of Illinois at Chicago

Ruann F. Ernst, Ph.D.
Director of Marketing
Hewlett-Packard Company

John Foster
Associate Professor
School of Engineering
Tuskegee University

Gregory H. Hamm
Director, Molecular Biology
Computing Laboratory
Rutgers University

Jerome P. Kassirer, M.D.
Associate Chairman
Department of Medicine
Tufts University

Bonnie L. Webber, Ph.D.
Associate Professor of Computer
and Information Science
University of Pennsylvania

Victor Lin-Kai Yu, M.D.
Associate Professor of Medicine
University of Pittsburgh

Appendix 5. Biomedical Library Review Committee

Programs and Services, FY 1988

The Biomedical Library Review Committee meets three times a year to review applications for grants under the Medical Library Assistance Act.

Members:

Joyce A. Mitchell, Ph.D.
Director, Information Science Group
University of Missouri-Columbia
(Chair)

Anthony R. Aguirre
Director of Library
Philadelphia College of Physicians

J. Robert Beck, M.D.
Associate Professor of Pathology
Dartmouth College

Virginia M. Bowden
Director, Briscoe Library
The University of Texas
San Antonio

Bruce G. Buchanan, Ph.D.
Professor of Computer Science
Philosophy, and Medicine
University of Pittsburgh

Nancy B. Fazzone
Director of Library Services
Salem Hospital (Mass.)

Charles P. Friedman, Ph.D
Director, Lab. for Computing
University of North Carolina

Reed M. Gardner, Ph.D.
Professor of Medical Informatics
University of Utah

Judith Messerle
Director, Medical Center Library
St. Louis University

Ramesh S. Patil, Ph.D.
Assistant Professor of Computer Science
Massachusetts Institute of Technology

Thomas E. Piemme, M.D.
Assistant Dean, Continuing Education
George Washington Univ. Medical School

Linda C. Smith, Ph.D.
Associate Professor
Graduate School of Library Science
University of Illinois

William W. Stead, M.D.
Director, Med. Center Information Systems
Duke University

D. Dax Taylor, M.D.
Medical Laboratory Director, MetPath
Wood Dale, Illinois.

Arthur L. Williams, Ph.D.
Associate Professor of Biology
Atlanta University

Appendix 6: Literature Selection Technical Review Committee

The Literature Selection Technical Review Committee meets three times a year to select journals for indexing in *Index Medicus* and MEDLINE.

Members:

Philip C. Anderson, M.D.
Chairman, Department of Dermatology
University of Missouri

Beverly H. Bonaparte, Ph.D.
Assistant Vice President
New York City Health and
Hospitals Corporation

Philip S. Brachman, M.D.
Master of Public Health Program
School of Medicine
Emory University

C. Michael Cashel, M.D., Ph.D.
Chief, Sec. on Molecular Regulations
National Institute of Child Health
and Human Development

Edwin L. Cooper, Ph.D.
Professor of Anatomy
University of California
Los Angeles

Lois E. DeBakey, Ph.D.
Prof. of Scientific Communications
Baylor College of Medicine

Dottie Eakin
Acting Head Librarian
Alfred Taubman Medical Library
University of Michigan

John. J. Frey, M.D.
Professor of Family Medicine
University of North Carolina

Albert E. Gunn, M.D. *(Chairman)*
Asso. Dean for Admissions
University of Texas Medical School
Houston, Texas

Robert J. Joynt, M.D. Ph.D.
Dean of Health Affairs
School of Medicine and Dentistry
University of Rochester

Alan S. Rabson, M.D.
Acting Director
National Cancer Institute

Reginald C. Tsang, M.D.
Director, Perinatal Research Institute
University of Cincinnati

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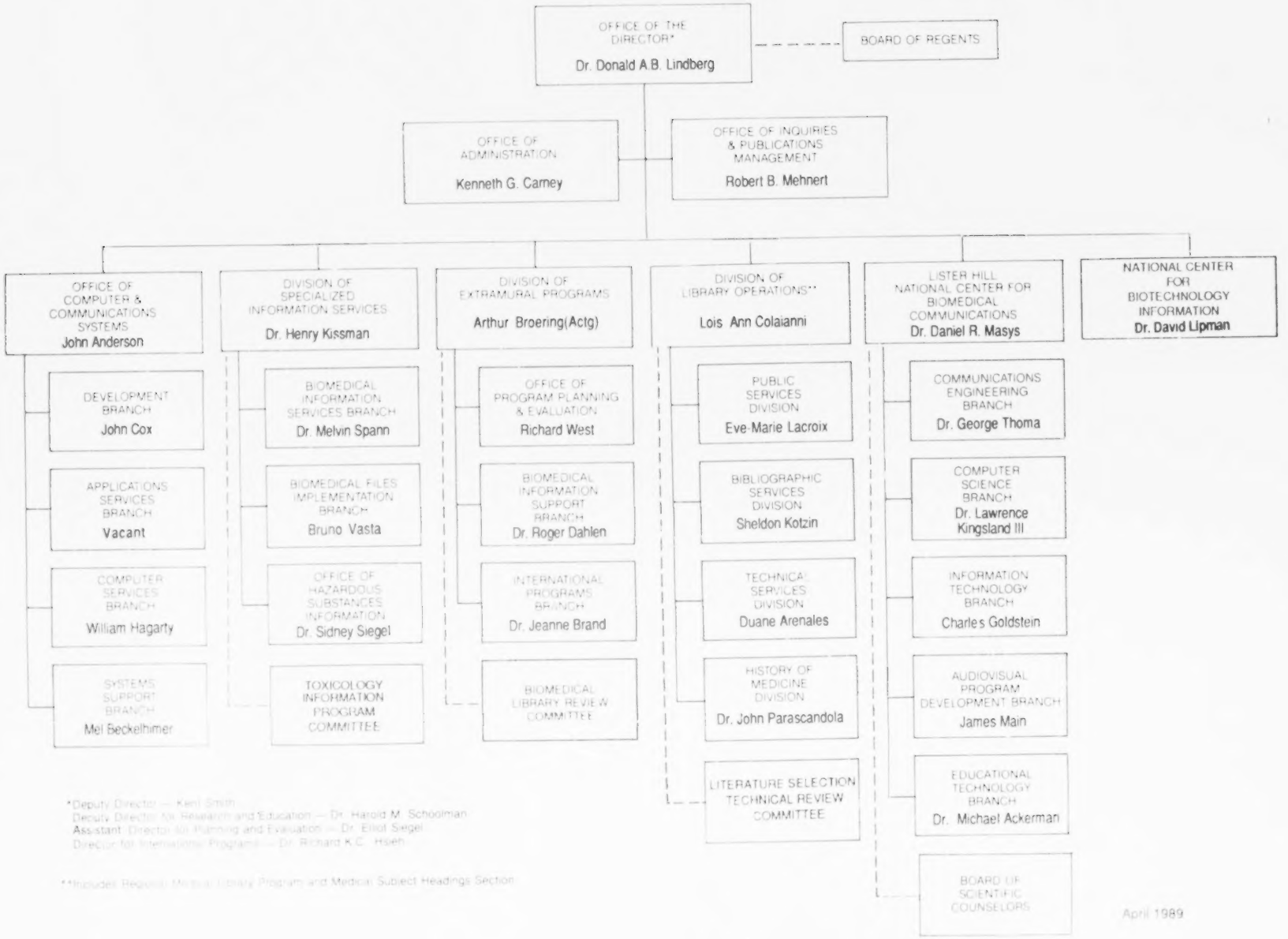
Organization Chart
National Library of Medicine



*Deputy Director — Kent Smith
Deputy Director for Research and Education — Dr. Harold M. Schoolman
Assistant Director for Planning and Evaluation — Dr. Elliot Siegel
Director for International Programs — Dr. Richard K.C. Hsieh

**Includes Regional Medical Library Program and Medical Subject Headings Section

April 1989